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EXCESSIVE HYPERTENSION OF LONG DURATION

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IN THE *Journal of the American Medical Association* of December 21, 1932, under the heading, "Queries and Minor Notes," appears the following question:

> Can you give me any statistics or other definite information of assistance in the prognosis of blood pressure? For example, how definitely can one say how long a person with a pressure of 200 systolic will survive, or one with 250, or one with a diastolic of 100 or 120? I realize that many factors enter in, but I am especially interested in the effect such high pressures have on individuals who show no cardiac or renal disease.

An answer to this question was prepared in the office of one of the largest insurance companies. Admittedly, it was incomplete and began, "There are no data available from insurance sources on the prognosis of individuals showing such high pressures, whether systolic or diastolic." Actually, the only available data that could give a real answer to the question are buried in the private records of practitioners who have followed hypertensive patients over long periods. If enough material could be obtained from such records by the collaboration of approximately a hundred physicians, real information would become available and the question could be given a definite answer.

The subject has great intrinsic importance, which has been considerably enhanced by public hypertensophobia. Such regrettable popular articles as that entitled "Killer Number One," which appeared in the *Saturday Evening Post* of December 16, 1944, have contributed to this state of affairs. Unfortunately, the medical profession has no reliable information on which to base reassurance of the unfortunate persons to whom the existence of high blood-pressure readings has been made known, and in whom a thoroughly reasonable anxiety state has been created.

When one encounters a young adult whose diastolic pressures range consistently over 120, whose eye grounds show extensive flame-shaped hemorrhages, exudates or edema, and who already presents evidence of cardiac or renal damage, there is no difficulty in estimating the prognosis. Such frank cases of hypertension of the malignant type are readily recognized and the gravity of the situation is universally understood. When, however, one is confronted by a patient with excessive hypertension (even with systolic pressures from 200 to 300 and diastolic pressures over 120), and when there is evidence that the condition is not progressive, when retinal changes are minimal and cardiac and renal damage not evident, there is no reliable information on which to base a prognosis.

No previously reported studies have attempted, so far as has been determined, to separate the obviously nonprogressive type of hypertension from the obviously malignant type, and to study the prognosis in the nonmalignant group alone. Although fairly large series have been studied by Janeway in 1913,[1] Rice in 1933[2] and several others[3–8] there has been no unanimity in the method of approach, and the results are difficult to evaluate. A recent communication by King, Carlile and Blackford,[9] which includes a follow-up study of 481 patients, is perhaps the most valuable that has yet been published. In their tabulations "essential" and "malignant" hypertension have been classed together. Their results, therefore, do not indicate what may be expected in the nonmalignant, relatively nonprogressive condition.

Furthermore, the importance of the diastolic pressure has not been sufficiently stressed. Most investigators have, however, pointed out that the presence of a relatively high diastolic pressure is a definitely unfavorable sign although in their statistics they have evaluated the degree of hypertension in terms of systolic as well as diastolic levels and therefore have failed to demonstrate the significance of high diastolic values. The conclusion that a high diastolic pressure carries with it a definitely poor prognosis is, I believe, in accord with the experience of clinicians generally, based

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on their impressions gained in routine practice, but accurate studies in relation to the age of the patient and the type of hypertension present have not, it appears, been made.

In still another respect previously reported studies of the prognostic significance of high blood pressure have failed to give the answer that is most needed. This is because the results are stated in terms that are difficult for the person untrained in

TABLE 1. *Status, in 1944, of 80 Female and 20 Male Patients with Excessive Hypertension* of Eight or More Years' Duration.*

STATUS OF PATIENT	NO. OF CASES	AVERAGE PERIOD OF SURVIVAL BELOW EXPECTANCY†
		yr.
Dead	33	2.5
Living	67	8.0
Disabled	19	
Active	48	

*Systolic pressure of 180 or higher, or diastolic pressure of 100 or higher.
†Life expectancy exceeded by 10 living and 10 dead patients.

dealing with insurance and mortality statistics to interpret. What the physician wishes to know about the hypertensive patient for whose welfare he is responsible is how this condition will affect the length of the patient's life and his health and happiness during the years he has yet to live — in other words, what the relation of this person's probable span of effective life is to that to which, at his age, he is entitled.

The present investigation has been undertaken in an attempt to make a small contribution to the

TABLE 2. *Status of Patients in 1947.**

STATUS OF PATIENT		NO. OF CASES
Living		47
In good health	30	
Slightly disabled	5	
Moderately disabled	3	
Markedly disabled	3	
Unknown	6	
Dead		53
Of cardiac disease	22	
Of cerebral disease	9	
Of renal disease	2	
Of unrelated cause	3	
Cause of death unknown	17	

*Thirty-two patients were from twenty-eight to fifty years of age, inclusive, 39 from fifty-one to sixty, inclusive, 18 from sixty-one to seventy, inclusive, and 11 from seventy to seventy-seven, inclusive.

mass of information that will be needed before an adequate answer to this question can be given. It consists entirely of a review of the records of private patients seen since 1914. With a view to finding out what happens to patients with excessive hypertension that is definitely not of the progressive, malignant type, patients were chosen in whom the condition had existed for at least eight years. Eight years without progression was regarded as evidence that malignant hypertension would not supervene. In the group of 100 patients here reported retinal hemorrhages were very rare, and renal failure occurred in only 1 case; no case of malignant hypertension developed. For the purpose of the present study a systolic pressure of 180 or a diastolic pressure of 100 was regarded as evidence of excessive hypertension. The records were reviewed and the first hundred patients who were found to have had a recorded pressure of this degree or higher, and who were alive eight years or more afterward, were selected.* Although many other patients with excessive hypertension of eight years' duration or longer have since been observed, it was recognized that by limiting the study to the patients who were seen earliest, the group would contain only cases in which a long follow-up study has been possible. Of the 100 patients, 90 were found to have had excessive hypertension prior to 1932, the remaining patients having first been observed in 1934, 1935 or 1936. In only 3 cases is the condition of the patient unknown at the present time. These 3 patients are reported as of their last recorded examination.

The average survival time was compared with the average life expectancy of all persons of the same age and sex.† The group then was divided

TABLE 3. *Comparison of Actual Duration of Life with Average Expectation of Life (1947).*

STATUS OF PATIENTS	AVERAGE EXPECTANCY	ACTUAL DURATION	DEFICIT
	yr.	yr.	yr.
Living	21.6	16.9	4.7
Dead	17.8	14.2	3.6
All patients*	19.8	15.7	4.1

*The average expectancy of life was exceeded by 28 patients.

into three parts: the living, the dead, and the physically incapacitated. The patients then were reclassified according to age, sex and degree of hypertension, — both systolic and diastolic pressures being ascertained, — so that the influence of these factors on length of life could be deduced.

The patients in this group were first studied in 1944. The results are recorded in Table 1.

In the three years that have passed since this earlier tabulation, 20 patients have died. At present there are 47 persons still living, and 53 who have died. Tables 2 and 3 give the main facts concerning the whole group. When another ten years have elapsed only a few of the patients will, in the normal course of events, still be alive. At that time a more final judgment regarding ultimate prognosis will be possible.

It is evident from these tables that the average person of the group lives out almost his entire life span. When the various factors that influence the

*For the initial readings in 1 case I am indebted to Dr. John E. Kenney, of Pawtucket, Rhode Island.

†On the basis of tables for males and females presented by Dublin.[18]

chances that any patient with excessive hypertension of long duration will live to his normal life expectancy are considered, the first factor of which one thinks is the age when the condition developed. In the patients reported it is notable that every person who was sixty-five years or over when excessive hypertension first was noted has outlived his life expectancy. The corollary to this statement, of course, is that persons in whom excessive hypertension was discovered relatively early in life and whose normal expectancy is therefore relatively long are unlikely to complete their life span. That this is true is demonstrated in Table 4, which shows what has happened to the 32 patients in whom the condition was discovered at the age of fifty

It is quite evident that an elevated systolic pressure is not, of itself, an unfavorable prognostic sign. In fact, the 27 patients who showed a systolic pressure of 250 or higher at some time while they were being observed lived distinctly nearer to their life expectancy than those in whom such high readings were never obtained. This is further emphasized by the fact that the 5 patients in whom a reading of over 300 was recorded on one or more occasions actually showed an average duration of life slightly in excess of the normal. The most probable explanation of these findings is that many of these patients with very high systolic pressures showed relatively low diastolic pressures. They belong to the group with arteriosclerotic hypertension in

TABLE 4. *Data in Patients Twenty-Eight to Fifty Years of Age.*

STATUS OF PATIENT	NO. OF PATIENTS	AVERAGE BLOOD PRESSURE		HIGHEST PRESSURE		AVERAGE BLOOD PRESSURE		LOWEST PRESSURE		LIFE EXPECTANCY	ACTUAL DURATION OF LIFE	DEFICIT
		SYSTOLIC		DIASTOLIC		SYSTOLIC		DIASTOLIC				
										yr.	yr.	yr.
Living	20	220.6		121.7		160		96.7		29.4	18	11.4
Dead	12	253.7		126.7		175		94.2		26.0	15	11.0

years or younger. This group is of particular interest because it is patients of fifty years or younger who are usually regarded as favorable subjects for dorsolumbar sympathectomy. Of these, the 12 patients who have died had lived an average of fifteen years, or eleven years short of their life spans. The 20 still alive have lived an average of eighteen years, or again about eleven years short of their normal expectancy. They are, all but 3, normal people who are living normal lives without symptoms. They probably will live enough longer to raise the average length of life for the group to a much more favorable figure. A question that should be considered is whether or not the long-range results of surgical treatment can be expected to be of benefit to these patients.

Regarding the influence of sex it must be admitted that a group of 20 patients is far too small to justify any definite conclusions. However, in these 20 male patients the average life expectancy for 8 patients alive in 1947 was nineteen years and the actual duration of life fifteen and three-fourths years, and the average expectancy for 12 dead patients was nineteen and a half years and the actual duration fifteen and a half years. The deficit for patients in the former group was slightly over three years, and that for patients in the latter was four years. The duration of life was slightly longer than the average for the total of 100 patients. The age at which the condition was first observed was one year earlier than the average for the entire group.

The influence of the degree of hypertension on the prognosis is demonstrated in Tables 5 and 6.

whom a loss of elasticity of the arteries, rather than degeneration of the arterioles, has led to excessive pulse pressures but not to marked organic damage other than cardiac hypertrophy.

This conclusion is upheld by a study of the facts presented in Table 6, which clearly indicate the unfavorable influence of a high diastolic pressure. In exactly 50 patients the diastolic pressure was found to have been, on one or more occasions, 120 or higher. In these patients the actual duration of life fell short of the normal expectancy by a considerably longer period than it did in the whole group. The other 50 patients, those whose diastolic pressure was never found to reach 120, showed,

TABLE 5. *Influence of Systolic Blood Pressure of More than 250.**

STATUS	NO. OF PATIENTS	AVERAGE LIFE EXPECTANCY	ACTUAL DURATION OF LIFE	DEFICIT
		yr.	yr.	yr.
Living	9	22.9	19.1	3.8
Dead	18	18.5	16.0	2.5

*Among 1 living and 4 dead patients with systolic pressures of more than 300, the average life expectancy was sixteen and the actual duration of life sixteen and three-fourths years.

of course, figures for duration of life that were correspondingly more favorable than those of the total group. It is interesting to note, however, that the 50 patients who had diastolic pressures above 120 were on the average several years younger than those with the lower diastolic pressures, and that the actual time of survival in the two groups was approximately the same.

This leads to a comparison of the actual survival time of these patients considered without reference to their life expectancy (Table 7). The deficit — that is, the number of years by which this survival time falls short of normal life expectancy — for each group is also shown in Table 7, which demonstrates that the various factors discussed (age, sex and degree of hypertension) do not cause a marked variation in the actual duration of life. Although older people tend to live up to or beyond their normal life expectancy, this is because their life expectancy is shorter. Their average duration of life is about the same as that of the younger group. It is, of course, true that as the 47 people who are still alive (30 of whom are in apparent good health) continue to live on, the average duration of life for the whole group will lengthen. One may say, then, that the prognosis in hypertensive patients of the type discussed is actually more favorable than the figures indicate. The shortest duration of life recorded in the whole series, after the discovery of the hypertension, is nine years, and the longest twenty-five years.

TABLE 6. *Influence of High Diastolic Blood Pressure.*

STATUS	DIASTOLIC PRESSURE OVER 120				DIASTOLIC PRESSURE UNDER 120			
	NO. OF PATIENTS	AVERAGE LIFE EXPECTANCY	ACTUAL DURATION OF LIFE	DEFICIT	NO. OF PATIENTS	AVERAGE LIFE EXPECTANCY	ACTUAL DURATION OF LIFE	DEFICIT
		yr.	yr.	yr.		yr.	yr.	yr.
Living	20	24.0	17.8	6.2	27	20.0	16.2	3.8
Dead	30	21.7	14.6	7.1	23	16.6	14.7	1.9

SUMMARY AND CONCLUSIONS

Hypertension, even of an excessive degree, that has been present eight years or more and is not associated with well established cardiac or renal disease usually does not indicate a poor prognosis. In fact the patient usually lives to within three or four years of his normal life expectancy.

Such hypertension does not commonly develop into the malignant type. In this series no case of such development was noted. It is not associated with marked arteriolar changes, evidenced by retinal hemorrhages or edema, or with renal damage — findings that are typical of malignant hypertension.

The most frequent cause of death in these patients is cardiac failure. A cerebrovascular lesion is the next most common terminal event.

The younger the patient at the time when the hypertension develops, the less likely he is to live out his full life span. Even in the young group (age fifty and below) the average length of life is over fifteen years (about eleven years below their expectancy). This is the age group in which dorsolumbar sympathectomy is usually recommended. For the malignant type of hypertension this operation is certainly of great value in delaying the fatal issue. With fifteen years or more of life ahead of him, however, it is questionable whether a person with the nonprogressive, nonmalignant type of high blood pressure should be subjected to such a radical procedure.

The present study does not indicate that the type of hypertension under discussion carries a poorer prognosis for males than it does for females. The group is too small to make this conclusion definite.

The degree of hypertension is important in relation to the diastolic pressure only. People with very high systolic pressures and relatively low diastolic pressures (the arteriosclerotic type of hypertension) survive appreciably nearer to their normal expectancy, on the average, than those with high diastolic pressures.

Regardless of sex or age or whether or not the diastolic pressure is below 120, this study indicates that these patients will probably live from fourteen to nineteen years. When the 47 patients now living have finished their lives, the figure will probably be considerably more favorable

TABLE 7. *Actual Duration of Life and Deficit in All Groups.*

GROUP	LIVING PATIENTS	DURATION OF LIFE	DEFICIT	DEAD PATIENTS	DURATION OF LIFE	DEFICIT
All cases	47	16.9	4.7	53	14.2	3.6
Patients 50 years of age or under	20	18.0	11.4	12	15.0	11.0
Male patients	8	15.9	3.0	12	15.5	4.0
Systolic pressure over 250	9	19.1	3.8	18	16.0	2.5
Diastolic pressure over 120	20	17.8	6.2	30	14.6	7.1
Diastolic pressure under 120	27	16.2	3.8	23	14.7	1.9

Further investigation of this subject should involve the collection of a sufficiently large number of cases to make statistical studies really significant. This could be accomplished by the collaboration of a large number of physicians who have practiced twenty-five years or longer.

It is suggested that when the physician is confronted with a patient who is not over fifty years old and in whom he finds excessive hypertension, frequent examinations should be made for evidence of progression, especially for the signs of retinal, renal or cardiac damage. In the absence of such evidence it is believed that resort to surgery may well be delayed.

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THE ECONOMICS OF INFANT AND CHILD NUTRITION*

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THE recent change in the world food situation from one of apparent relative adequacy to one of obvious deficit invites a brief review of the economics of providing infants and children with an adequate diet. In this connection total calories and protein appear to deserve the most consideration. Moreover, requirements for these two components must be considered together because the protein needs of the growing child within certain limits are inversely proportional to the total caloric intake. This is due in part to the fact that the amino acids of dietary protein are needed and used for energy when calories from nonprotein sources are insufficient.

TABLE 1. *Recommended Dietary Allowances.**

AGE	TOTAL CALORIES	PROTEIN
yr.		
Under 1	100†	3-4†
1-3	1200	40
4-6	1600	50
7-9	2000	60
10-12	2500	70
13-15	2800-3200	80-85‡
16-20	2400-3800	75-100‡

*Based on allowances recommended by the National Research Council.[1]
†Per kilogram of body weight.
‡The first value is for girls, and the second for boys.

Table 1 sets forth the allowances for total calories and for protein recommended by the Food and Nutrition Board of the National Research Council in 1943. Experience in this clinic leads us to believe that these caloric allowances are approximately correct.[2] On the other hand, studies carried out both here and elsewhere[3-8] suggest that the recommended allotments of protein may be appreciably in excess of actual requirements under conditions of ample caloric intake. Assuming, therefore, that the recommendations of Table 1 are ample, the following considerations appear pertinent.

The daily recommended allowances for an average five-year-old child weighing 18 kg. are 1600 calories and 50 gm. of protein, providing 90 total calories and 2.8 gm. of protein per kilogram of body weight. Theoretically, this food can be made up exclusively of vegetable nutrients or can be comprised of a mixture of vegetable and animal substances. When the caloric allotment is provided entirely by a mixture of such vegetable substances as wheat, corn meal, oats, potatoes, beans, peas, soybeans and carrots (Table 2), the protein intake is 75 gm., or 4.2 gm. per kilogram of body weight per day. Even if 30 per cent of the calories come from a mixture of oranges, peaches, apples, tomatoes and cabbage and the remaining 70 per cent is derived from the substances mentioned above, the protein intake is about 64 gm., a value in excess of that recommended in Table 1. These data and experience with diets for metabolic ward patients indicate that, quantitatively speaking, it is difficult to feed a child

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enough calories from a mixed diet without at the same time giving him at least 2 gm. of protein per kilogram of body weight daily. Incidentally, cereal-vegetable-fruit diets yielding 1600 calories can also contain over 600 mg. of calcium, an ample amount.[9]

So far as is known, there is no objective evidence that mixed cereal-vegetable proteins are qualitatively inadequate. That such regimes are at least compatible with survival is attested by the fact that the poorest peasants in southern Italy have lived on corn meal, green stuffs and olive oil and have done so for generations.[10] Meat in the form of fat pork was taken three or four times a year. There was no milk, cheese or eggs in their dietary. In China the diet is also largely vegetarian. It becomes of interest, therefore, to calculate the relative costs of substituting animal for vegetable is used to raise a mixture of the various animal proteins listed in Table 3, the yields of calories (214,000) and of protein (10 kg.) are reduced to approximately 20 per cent of those derived from the mixed vegetables and fruits.

Re-expressed in terms of the productivity of 100 man hours of farm labor, the average yield in the form of the vegetable-fruit nutrients exclusive of sugar is 4,400,000 calories and 220 kg. of protein. In the form of animal nutrients, the average yield from the same effort is about 640,000 calories and 28 kg. of protein, or but 15 per cent of the productivity described for vegetables and fruit.

These data are reconsidered in Table 4, which presents calculated approximate costs of feeding a five-year-old child for an average day with vegetable-fruit vs. animal-nutrient types of diet. It

TABLE 2. *Yield of Vegetable and Fruit Nutrients per Acre and per 100 Man Hours of Farm Labor.**

TYPE OF NUTRIENT	CALORIES		PROTEIN		CALCIUM	
	PER ACRE	PER 100 MAN HR.	PER ACRE	PER 100 MAN HR.	PER ACRE	PER 100 MAN HR.
			kg.	*kg.*	*gm.*	*gm.*
Sugar†	6,634,000	2,787,000	0	0	0	0
Wheat, whole flour	1,132,000	12,582,000	41	450	167	1,852
Corn meal, yellow	1,122,000	4,109,000	26	95	31	114
Oats, rolled	987,000	10,963,000	35	390	202	2,245
Potatoes	2,283,000	3,358,000	53	79	348	511
Beans, dry	1,081,000	4,159,000	68	260	457	1,756
Peas, dry	1,248,000	—	86	—	257	—
Soybeans, whole	1,545,000	12,879,000	153	1,238	1,001	8,343
Carrots	2,685,000	829,000	75	23	2,381	735
Cabbage	870,000	799,000	43	40	1,459	1,339
Tomatoes	408,000	242,000	18	11	198	117
Apples	1,073,000	873,000	6	5	98	80
Peaches	939,000	751,000	8	6	150	120
Oranges	1,909,000	1,224,000	31	20	1,264	810
Averages	1,325,000	4,400,000	49	220	615	1,300

*Adapted from Christenson.[9]
†Excluded from averages.

TABLE 3. *Yield of Animal Nutrients per Acre and per 100 Man Hours of Farm Labor.**

TYPE OF NUTRIENT	CALORIES		PROTEIN		CALCIUM	
	PER ACRE	PER 100 MAN HR.	PER ACRE	PER 100 MAN HR.	PER ACRE	PER 100 MAN HR.
			kg.	*kg.*	*gm.*	*gm.*
Whole milk	352,000	791,000	18	40	603	1,354
Eggs	144,000	313,000	12	25	49	108
Broilers and chickens	113,000	300,000	12	31	10	25
Hogs (pork and lard)	300,000	1,618,000	8	26	5	17
Steer	57,000	289,000	4	19	2	11
Lambs	115,000	521,000	6	26	4	20
Averages	214	640	10	28	112	256

*Adapted from Christenson.[9]

nutrients or of adding extra animal-protein-containing foods to the vegetable regime. Tables 2 and 3 provide a basis for comparison.

When an average acre of land is used for raising the mixture of vegetables and fruits mentioned above, the average yield per acre is 1,325,000 calories and 49 kg. of protein (Table 2). If an acre of land is used for raising sugar, the yield of calories is relatively much larger (6,600,000), but the protein yield is zero. By contrast, when an average acre can be seen that the use of animal instead of vegetable-fruit nutrients greatly increases the costs of feeding. Viewed in these lights it seems that to include animal nutrients in the diet of children — and incidentally, of adults — may be more of an economic luxury than a nutritional necessity. Actually, as McCollum[11] has said, it is possible to make a fairly satisfactory diet of foods derived entirely from vegetable sources. But it is not easy to do so because vegetable foods tend to be bulky.

Moreover, many vegetables are of relatively low protein and mineral content, and some are deficient in certain essential amino acids. Hence it is only by careful selection and planning that an adequate vegetarian diet can be devised. For practical purposes, therefore, it is usually much easier to provide adequate nutrition with diets containing some animal nutrients. Milk is well suited both economically and nutritionally to this purpose. When only 10 per cent of the total calories are provided by milk, nearly 0.5 gm. of protein and 16 mg. of calcium per kilogram of body weight are supplied by the milk alone. Because milk is relatively inexpensive to produce, its inclusion to this extent raises the total cost of feeding relatively little (38 per cent) above that calculated for an all-vegetarian regime.

A further illustration of the economics of prescribing diets made up of different proportions of calories (about 100 per kilogram) of body weight and water (150 cc. per kilogram). However, because of variations in the amounts of milk and sugar used, the protein, fat and sugar allowances of each formula are different. For purposes of comparison, values for human milk are given at the bottom of the table.

Formulas A and B correspond closely to those commonly prescribed. When compared to human milk, it is seen that they provide about twice the quantity of protein taken by a breast-fed baby. The same thing is true of such minerals as sodium, potassium, calcium, chloride and phosphorus, the concentrations of which are three or more times greater in cow's than in human milk.[12, 13] Even Formula C, the cow's milk content of which is about half that commonly recommended, yields more protein and minerals than an equivalent volume of human milk. Yet this formula approximates the recommendation of Powers[14] that between 10 and 20 per cent of the total calories come from protein, 15 to 30 per cent from fat and 50 to 70 per cent from carbohydrate and the daily requirement of 2.2 gm. of protein per kilogram of body weight reported by Levine.[15]

The relative costs of these formulas are estimated in the right-hand section of the table. It is to be noted that there are two columns under "cents," one of which is computed on the basis of whole milk and the other on the basis of evaporated milk. Formula C costs from one third to one half less than Formulas A and B, whether the measure of cost be monetary, acres of land or man hours of farm labor.

It is possible to make an approximate comparison between the costs of cow's milk vs. human milk for infant feeding. It appears that human milk is produced with high efficiency (more than 90 per cent).[16] If, therefore, a mother derives the vegetable vs. animal nutrients is provided by infant formulas. Table 5 presents information concerning the composition and costs of three arbitrarily selected cow's milk formulas that theoretically might be fed an infant weighing 4 kg. Each of these provides the same allowance of total extra calories and other nutrients necessary for milk production from appropriate vegetable-fruit nutrients similar to those illustrated in Table 2, the cost in acres and in man hours of farm labor is roughly half that of Formula C. On the other hand, if she obtains these extra calories by drinking cow's

TABLE 4. *Approximate Costs To Feed a Five-Year-Old Child 1600 Calories a Day with Diets Made up of Various Proportions of Vegetable-Fruit vs. Animal Nutrients.**

TYPE OF DIET	SOURCE OF CALORIES		COST		COST RELATIVE TO DIET A	
	VEGETABLE-FRUIT NUTRIENTS	ANIMAL NUTRIENTS	ACRES OF LAND	100 MAN HR. OF FARM LABOR	LAND	LABOR
	% of total	% of total	$\times 10^{-3}$	$\times 10^{-3}$	%	%
A	100	0	120	36	100	100
B	90	10	183	57	152	158
C	80	20	246	79	205	219
D	70	30	309	100	258	278
E	60	40	372	122	310	340
F	50	50	435	143	362	397
G	40	60	498	164	415	455
H	30	70	561	186	467	515
I	20	80	624	207	520	575
J	10	90	687	229	570	635
K	0	100	750	250	625	695

*Calculations based on average yield of calories per acre and per 100 man hours given in Tables 2 and 3.

TABLE 5. *Comparative Costs of Equicaloric Cow's Milk Formulas and Human Milk.*

FORMULA	COMPOSITION*			PROTEIN	SOURCE OF CALORIES			DAILY COST†			
	WHOLE MILK	ADDED CARBOHYDRATE	ADDED WATER		PROTEIN	FAT	CARBOHYDRATE	ACRES	100 MAN HR.	CENTS	
	cc.	gm.	cc.	gm./kg./day	%	%	%	$\times 10^{-3}$	$\times 10^{-3}$	whole milk	evaporated milk
A	600	0	0	5.3	22	49	29	120	53	13.2	7.5
B	400	33	200	3.5	15	32	53	82	40	9.9	6.1
C	250	57	350	2.2	9	20	71	53	30	6.6	4.2
Human milk	600	0	0	1.9	7	52	41	35‡	11‡	—	—

*Based on average values given in the literature.[12, 13]

†Based on values given in Tables 2 and 3, in addition to chain-store prices in Boston on December 29, 1947 (fresh milk, $0.22, evaporated milk diluted to whole-milk strength, $0.125 per liter, and sugar, $0.20 per kilogram).

‡Assuming that extra food required for milk production is derived entirely from the vegetable nutrients listed in Table 2.

milk, the costs are increased about fivefold and become comparable to those of Formula A.

Discussion

The foregoing analysis sets forth some approximate information concerning average economics of human nutrition. It does not take into account variations in the agricultural potentialities of various geographical areas. Nor does it consider the important though less readily defined factors concerned with the flavor of food, the pleasure of eating and the influence on morale of palatable meals. A consideration of vitamins also has been omitted, though with the exception of vitamin D and possibly of riboflavin, vegetarian diets that are adequate in calories and protein appear to be satisfactory in other respects.

This information is of no moment to peoples who can afford what they want. It is of potential importance only when thrift is a necessity. The data presented provide no basis for recommending that animal be discarded entirely in favor of vegetable nutrients. On the other hand, they suggest that, when survival depends on getting enough to eat, due thought be given to the wastefulness of recommending more than minimal essential allowances of the animal type of nutrient.

Unfortunately, extensive data defining the minimum requirements of normal infants and children for protein, either animal or vegetable, are not available. In most of the published studies of protein requirements, the allowances of total calories were increased or decreased in approximate proportion to the protein allowances. Under these circumstances changes in nitrogen balance could have been due to changes in caloric intake as much as or more than variations in protein intake. Studies carried out in this clinic on healthy children two to ten years old suggest that when the caloric intake is ample, no improvement in the nitrogen balance is obtained by the daily administration of more than 2 gm. of mixed protein per kilogram of body weight.[8] More detailed information of this type should be of value especially regarding infant feeding in areas where cow's milk is scarce. For example, the same quantity of cow's milk dispensed as Formula C (Table 5) would feed one and a half times as many infants as it would dispensed as Formula B and nearly two and a half times as many as it would dispensed as Formula A.

These findings give some scientific substance to the Chinese proverb: "20 ounces of chicken costs 20 pounds of rice."

Summary and Conclusions

A brief survey of the approximate, relative costs of feeding infants various types of formula and children cereal-vegetable-fruit diets vs. diets of equal caloric and protein content containing animal protein and fat is presented.

When thrift is necessary it is wasteful to feed babies by bottle or to provide more than minimal essential allotments of the animal-protein type of food for older children and adults.

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BOSTON MEDICAL LIBRARY

Report of the President*

IN accordance with a long established custom it is my privilege to submit my second annual report as president of the Boston Medical Library.

Since our last annual meeting the active participation of the Massachusetts Medical Society in the affairs of the Library has become a fact. Every member of the Massachusetts Medical Society in good standing is now a Society member of the Library entitled to all the rights and privileges, except the right to vote, which by virtue of our charter is vested solely in the fellows. The Society allots $5.00 of each member's dues toward the maintenance of the Library.

In view of this response to our appeal it seemed right and proper that the Society should have some voice in the management of the Library. Accordingly a special meeting of the Corporation was called, and the by-laws amended, to increase the membership of the Board of Trustees from twelve to sixteen, the Massachusetts Medical Society being invited to appoint four of that number. This invitation was accepted by the Council, and the president of the Society has appointed four trustees to serve one, two, three and four years respectively. Hereafter one new member will be appointed yearly. The additional income received will enable us to enlarge our personnel and increase our service.

Although we are grateful for this financial aid, we are still more grateful for the increased interest in the Library and hope that it will mean a much greater use of its resources by the members of the Society.

We have continued our efforts to put our house in order. Many volumes have been transferred to the Deposit Library in Cambridge. Many duplicates have been sold. Much remains to be done, but with the increase in our personnel we hope to progress steadily. The trustees have authorized the Librarian and the Director to enlarge our staff and several new members have already been appointed, but the reorganization must necessarily proceed slowly because of the lack of properly qualified persons to fill the positions.

We are greatly hampered by lack of stack room—five tiers of stacks in the fireproof ell have never been installed. The space where the stacks should be is now partially filled with volumes on temporary shelving on temporary scaffolding. This makes proper servicing a difficult if not an almost impossible accomplishment. If we are to give adequate service these stacks and the service elevator must be installed. This will entail an expense of about $75,000. How this can be financed is one of the many problems that confront us. It has been suggested that we solicit voluntary contributions, or that we borrow the money and set up a sinking fund to amortize the loan. I request that this be given serious thought.

In considering our financial setup it must be remembered that nearly two thirds of our invested funds are held in trust, the income only to be used for special purposes. Thus, we are committed to purchase rare books, or books on special subjects. We need a much larger unrestricted endowment to purchase current periodicals and volumes. Thanks to the care of the Treasurer, our funds, such as we have, are in excellent condition.

A certain portion of our income must be set aside each year for maintenance and repair of our building. Various repairs are imperative, and much painting needs to be done. The periodical room, which has never been finished, should be put in proper condition as soon as possible.

Very few fellows have resigned, scarcely more than the usual number. This is very gratifying. The fellows constitute the legal corporation of the Library. They are the custodians of its building, its books and its funds. They elect its officers and a majority of its trustees. This corporate body should be larger than it is now, so that the responsibility of this valuable institution may be shared by a large group. The additional income will also help. It may be possible in the future to provide more privileges for the fellows. I hope that each of us will propose one or more fellows during the coming year.

We are again grateful for the devoted services of the Librarian and the Director and our faithful staff. They have accomplished much under trying circumstances.

The Librarian will present a more detailed report on the present condition of the Library and his plans for the future. The number of visitors to the Library is increasing, and much more interest is apparent among the medical profession.

We are far from our goal, but with the hearty cooperation and support of the fellows and the new Society members, we have great hopes for the future.

WALTER G. PHIPPEN

*Presented at the annual meeting of the Boston Medical Library, April 26, 1948.

Report of the Librarian*

IT IS again the privilege of the Librarian to present to the Corporation of the Boston Medical Library his annual report — in this instance, his tenth accounting of the state of the Library. In general the year has been a good one, with a marked increase in use of the Library both by our readers and by those who borrow material from us. The addition of two persons to the staff has provided more and prompter service than we ever were able to offer before. The Library has continued to grow in size as well as in usefulness. In spite of inadequate stacks, poor lighting, unfinished rooms and an untidy duplicate storehouse, our books are still intact and our periodical files in reasonably good shape, and our treasures can be made available to all who knock on our door with scholarly intent and reasonable patience. The Director, whose knowledge of our Library affairs and medical librarianship in general is unexcelled, continued to serve, even on Sundays, those who most needed his help.

Service to Readers

Our readers consist of the fellows, members of various classes, including the newly formed Massachusetts Medical Society members, students who are not members and the general public. We serve all, without distinction so far as the use of our collection is concerned in Holmes Hall. Many of the users, over 9000 in 1947, were neither fellows nor members, coming from classes not supporting the Library financially. To this service to the public the Library is dedicated.

The attendance in 1947 was not quite so large as in 1946, but nearly up to the average of the prewar years. Of more importance is the use of the collections; it was larger in 1947 than in any year in our history, with the exception of one year when the Harvard Medical School Library was closed and many of its readers came to the Boston Medical Library for their bookish inspiration. Thus we went ahead in 1947 of our prewar circulation rate, with the use of 42,638 books and periodicals, compared with 38,266 in 1946 — a healthy sign in a growing institution. At the same time the interlibrary loans to other institutions doubled, by far the greatest use of our Library in this department ever experienced.

The Library, moreover, increased in size by over 2500 volumes and nearly 4000 pamphlets. Owing to increased personnel we were able to prepare and bind more than 1600 periodical volumes, 1000 greater than in 1946. Thus, the Library furnished more material to its readers in 1947 than ever before, and this service was rendered by our old staff and the two additional and very welcome new members.

*Read in part at the annual meeting of the Boston Medical Library, April 26, 1948.

Accessions

Seven incunabula were added to the Library in 1947, bringing our total to 696. They included *De anima* of Alexander of Aphrodisias, three other copies of which were listed by Stillwell as in libraries in the United States. Alexander was a Greek philosopher and commentator on the writings of Aristotle who lived in Athens at the beginning of the third century A.D. Sarton describes him as "the greatest scientific thinker of the time." A general study of Alexander's work in science is badly needed.

Another addition was the second printing of the *Articella*, a popular collection of the writings of Galen, Hippocrates and others, widely used by students in the fifteenth century. The Library has two other incunabula editions of this book, now having three of the six recorded printings before 1501.

The Library has an unusually complete run of the first printings of the works of Michele Savonarola, the physician and grandfather of the Dominican martyr, Girolamo Savonarola. Two further editions were added in 1947, the rare *De aqua ardenti*, published in Pisa in 1484 (Fig. 1), and a copy of *De febribus*, issued at Venice in 1496.

Giovanni Michele Savonarola, physician to the famous Este family of Italy, was born at Padua in 1384 and died in 1462, neither date being clearly fixed. All his works were orginally circulated in manuscript and only printed posthumously. The most popular was his *Practica de aegritudinibus*, edited by Alexander Sermoneta and Joannes Aquilanus, first published as a printed book at Colle di Valdelsa by Bonus Gallus in 1479, seventeen years after the death of the author. Before that time eager students were forced to use manuscripts, some with faulty copy and all of them both scarce and expensive. With printing, the floodgates of learning were open: two more editions were demanded before 1501, and the book was frequently reprinted in the sixteenth century, filling a need long after the author's death.

The *Practica* is Savonarola's chief medical work and was probably finished by 1440, for a manuscript edition is known of that date. It was written at Padua, where he received his degree of doctor of medicine from the University on August 20, 1413, and later taught and practiced. After 1440 he became physician to Niccolo III, marquis of Este. After the death of Niccolo he served Lionello and then Borso d'Este in the same capacity. The *Practica* deals, according to Lynn Thorndike, with the causes and cure of disease, prognostics, the physician's personality, foods and medicines and their effects, the last being largely taken from Avicenna.

In *De aqua ardenti* Savonarola accepts alcohol as an essential medicine and recounts the lives of noted

men who lived long by using it. The single edition of this work was printed in 1484.

A third book was a treatise on fevers, thrice printed before 1501 and frequently in the sixteenth century. All the incunabula editions are in the Library. Another book is *De pulsibus, urinis et egestionibus*, 1487 and 1497, both editions being in the Library.

His best known work is on baths and mineral springs, printed in Ferrara in 1485. There are three incunabula editions, of which the Library has two (1485 and 1496). The book was probably written before 1450 and later revised before his death in 1462. A work on physiognomy exists only in manuscript. A vernacular text on gout, possibly taken in part from his *Practica* was printed in 1505. Both in the work on physiognomy and in that on baths, Savonarola showed originality; his *Practica* and other medical writings appear to be ordinary treatises of their time.

Three books, illustrating the spirit and practice of medicine in the sixteenth century, were also added in 1947. The first is by a priest from Steinheim who combined in one volume three of the most popular and widespread beliefs of his time — astrology, physiognomy and chiromancy. The book was published in 1522 in Strassburg and was frequently reprinted for the next one hundred and fifty years. Three Latin printings were needed the first year, and the text was soon set in German, English and French. The *Chiromantia* of John ab Indagine, or von Hagen, was one of the most popular books north of the Alps. John ab Indagine, a humanist who was not afraid to attack scholastic theology, was a friend of a fellow priest, Otto Brunfels, the herbalist. Some even thought him a Lutheran, and he, like Savonarola, sought the greater tranquillity in letters. He was not a great man, but a stern and resolute face stands out on the title page of his book (Fig. 2). His works reached England through the books of Fabian Withers.

The medieval and Renaissance practitioner was fond of one-volume libraries, something he could slip in his saddle-bag and turn to when faced with any occasion — medical, surgical, astrologic or even spiritual. Such is the *Collectanea Medica* manuscript of 1450 in our Library, the *Articella*, mentioned above, and the Artzneybuchs of later dates. A good example of the last is the one issued at Nuremburg in 1549 (Fig. 3), consisting of medical treatises of practical interest, including obstetrics and a dental tract.

The third book is on old age and how to prolong life beyond the short span common in the sixteenth century. The most noted book of this type was *De La Vita Sobria* of Luigi Cornaro, first published in Padua in 1558. Cornaro lived to be one hundred years old, but Thomas Philologus of Ravenna, also called Tommaso Rangoni, whose book, *De Vita Hominis Ultra CXX Annos Protrahenda*, the Library acquired in 1947, tried to prolong human life beyond one hundred and twenty years. Thorndike tells us that Philologus began writing prognostications as early as 1515, taught logic at Padua and then astronomy. He lectured at Bologna, became physician to Cardinal Grimani, a public teacher of astrology at Rome and finally a popular professor at Padua, where "enthusiastic students carried him around town on their shoulders." The town echoed with his name and it was written all over the walls of

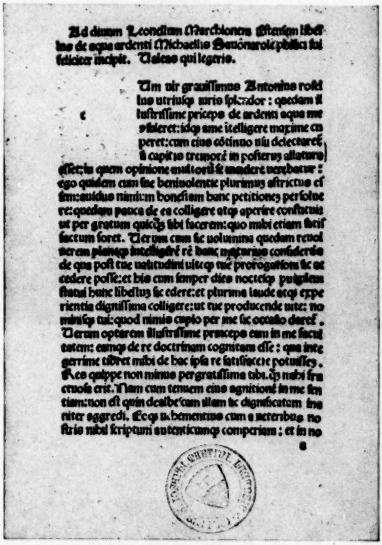

FIGURE 1. *First Page of* De Aqua Ardenti, *by Michele Savonarola (Pisa, 1484).*

buildings. In turn Philologus endowed a college at Padua for thirty-two students from his home city of Ravenna and restored churches and other buildings at Venice. In 1575 he published a tract on syphilis. The edition of *De Vita* in the Library was published in Venice in 1550 (Fig. 4).

One other accession is of particular interest. The anatomist, Remmelin, wrote a famous atlas, the *Catoptrum Microcosmicum*, showing the human figure in a series of superimposed plates. The book was first issued with a Latin text in 1613 and was frequently reprinted. The Library has an edition of 1660. The book also appeared in German, and the Library has the 1632 edition, printed at Ulm. In 1947 we acquired an English edition, *A survey of the Microcosme; or the Anatomy of the Bodies of*

Man and Woman, the gift of one of our trustees, printed in London in 1695. All three books have the

CHIROMAN
TIA.
1 Physiognomia, ex aspectu membrorum Hominis.
2 Periaxiomata de Faciebus SIGNORVM.
3 Canones Astrologici, de iudicijs Ægritudinum.
4 ASTROLOGIA NATVRALIS.
5 Complexionum noticia, iuxta dominium Planetarum.
Autore IO. INDAGINE. 1521.

FIGURE 2. *Title Page of* Chiromantia, *by John ab Indagine (Strassburg, 1541).*

fine, but fragile, superimposed plates in good condition.

CHARLES FAIRBANK PAINTER

Dr. Charles F. Painter died suddenly at his home, January 6, 1947. He served as librarian of the Boston Medical Library from 1929 to 1937, following Dr. John W. Farlow, who had been librarian since 1905. Dr. Farlow augmented the work of the first librarian, Dr. Chadwick, who had started the Library on its modest career in 1875 only to see it develop into a medical institution of considerable proportions by 1905. It was Chadwick who saw us into our present house. Dr. Painter, in turn, continued the fine standards set by his predecessors. He carried the Library, moreover, through a period of decreasing financial support, without materially reducing the service to its members. He was as de-

voted to the Library as he was to his chosen profession of orthopedic surgery and to Tufts College Medical School, where he served as dean from 1913 to 1922. One of his avocations was the history of medicine, and naturally he turned to the Boston Medical Library as a source of inspiration, believing at

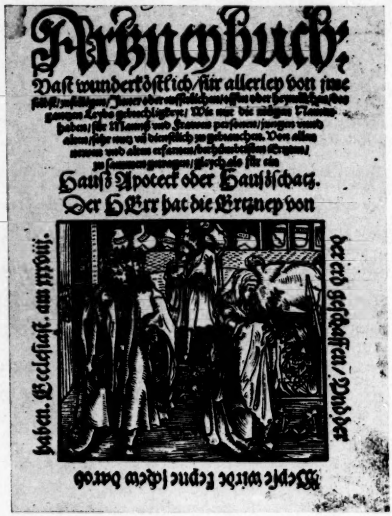

FIGURE 3. *Title Page of* Artzneybuch (*Nuremburg, 1549*).

the same time that he might contribute, at least in his modest way, to the work of the Library.

Dr. Painter was born in Grand Haven, Michigan, May 19, 1869. Coming from an old Virginia family, he enjoyed the reunions of the Painter family held at Pulaski, Virginia, a delightful region between the Blue Ridge and the Allegheny Mountains. He received the degree of A.B. in one of the earlier classes of the newly founded Johns Hopkins University in 1891. After four years of study at Harvard Medical School he received the degree of M.D. in 1895. In his class were many men whose names are well known to the members of the Boston Medical Library. They include Joseph Capps, Arthur Chute, Amory Codman, Harvey Cushing, Elliott Joslin, Timothy Leary, William Robey and Franklin White, many of whom were destined to make their names known not only in this country but also abroad. Harvey Cushing was closely associated with Charles Painter during his four years in the Medical School, and it was Cushing who wrote in a letter to his father, dated January 31, 1892:

> Painter I like very much. He is slow, but hangs on to everything he gets. He hails from Great Barrington, Mass. and is a great big solid whole-souled creature such as one likes to meet.

They both went to Massachusetts General Hospital, where Painter was associated with E. H. Bradford, Robert Lovett and the other brilliant orthopedic pioneers of the time. He was surgeon-in-chief at the Carney Hospital for many years.

Even before he was chosen librarian in 1929, Dr. Painter had long been interested in the Boston Medical Library and had served on a number of commit-

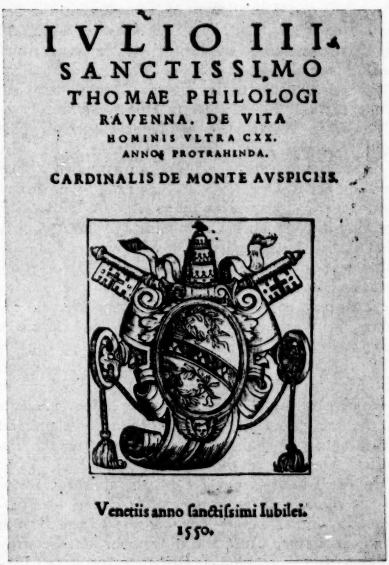

FIGURE 4. *Title Page of* De Vita Hominis Ultra CXX Annos Protrahenda, *by Thomas Philologus* (*Venice, 1550*).

tees. His literary endeavors, moreover, led to the creation of a chair of the History of Medicine at Tufts College Medical School, a position occupied by him for a number of years. He edited the *Yearbook of Orthopedic Surgery* and served for a long period on the editorial board and briefly as the editor of the *Journal of Bone and Joint Surgery*. He was president of the American Orthopaedic Association in 1915-1916.

The Library loses a friend of many years' standing. Although heavily engaged in the active practice of surgery he was always ready to devote time to Library activities. His heart, moreover, was truly in the field of literature as well as in the practice of medicine. He was essentially a scholar both of orthopedics and of medical history. Indeed we can truly proclaim with his contemporary, Harvey Cushing: Dr. Painter was a "solid whole-souled creature such as one likes to meet."

Library Activities

Addresses and Meetings

The Librarian addressed the Section of Neurology and Psychiatry of the New York Academy of Medicine on "The History of Neurology in the Last Hundred Years," in New York City on March 11, 1947; the session on the History of Medicine, American Medical Association, on "American Medicine in the Massachusetts Bay Colony," at Atlantic City, June 11; and Massachusetts Historical Society on "Benjamin Waterhouse on Luigi Cornaro's *Long and Healthful Life*," Boston, October 9.

The Director and the Librarian attended a farewell dinner to Dr. Henry E. Sigerist, former professor of medical history at Johns Hopkins University, in May in New York, the meetings of the American Association for the History of Medicine and the annual session of the Medical Library Association, held at Cleveland the same month, and the meeting of honorary consultants to the Army Medical Library in Washington in October. The Librarian also visited the Medical Library of Duke University, the Welch Medical Library in Baltimore and the Medical Library of the New York Academy of Medicine during the year and made numerous visits to the Army Medical Library, both in Cleveland and Washington, as chairman of the Committee on Historical Medicine of the last institution.

In April Miss Genevieve Miller, assistant editor of the *Bulletin of the History of Medicine*, was tendered a dinner before her address to the Boston Medical History Club, and in October Mr. Geoffrey Keynes, the distinguished British surgeon and bibliographer, was a guest of the Librarian in Boston.

Book Reviews

About 250 books, received from the *New England Journal of Medicine*, were reviewed in 1947, either by short notes (about 100) or by longer, critical reviews. The short notes were mostly written by Mr. Ballard, and the reviews by some of our 96 devoted reviewers, whose names are listed semiannually in the *Journal*. The Library is indebted to the *Journal* for the books and to the reviewers who carefully evaluate the current literature and, in most cases, courteously deposit the book in the Library for the benefit of our readers.

Exhibits

The exhibit of the "Ether Demonstration" was held over for the first half of 1947 and was followed by an exhibit of material relating to the "History of the Boston Medical Library," showing the earliest catalogues of 1807-08, pictures of the various buildings used for the Library on Hamilton Place, Boylston Place and The Fenway, "The Want Book," or "Periodical Deficiency List" of Dr. James Read Chadwick and other memorabilia, arranged by Mr. Ballard.

Publications

Recent articles emanating from the Library are as follows:

Seventy-first Annual Report of the Boston Medical Library for the Year 1946. 42 pp. Boston: privately printed, 1947.

Viets, H. R. Boston Medical Library: Report of the librarian. *New Eng. J. Med.* **237**:14-20, 1947.

Phippen, W. G. Boston Medical Library: Report of the president. *New Eng. J. Med.* **237**:12, 1947.

Editorial. Fulton's Harvey Cushing. *New Eng. J. Med.* **236**:153-155, 1947.

Viets, H. R. Harvey Cushing by John F. Fulton (book review). *Atlantic Monthly* **179**:138, 1947.

Idem. Charles Fairbank Painter, 1869-1947. *New Eng. J. Med.* **236**:642, 1947.

Idem. In honor of Harvey Cushing. *Bull. Hist. Med.* **21**: 403, 1947.

Editorial. Passing era in medical history. *New Eng. J. Med.* **237**:106, 1947.

Viets, H. R. Edward Clark Streeter, 1874-1947. *Bull. Hist. Med.* **21**:843-845, 1947.

Idem. Walter Channing (1786-1876): Pioneer in obstetric anesthesia. *North Carolina M. J.* **8**:418, 1947.

Varia

In 1947 the second edition of *A History of Medicine*, by Arturo Castiglioni, edited by Dr. E.B. Krumbhaar, was published. This monumental work, of particular importance for its discussion of the Italian influence on the Renaissance, was brought up to date by the inclusion of events in medicine occurring during the last six years since the first edition. A new history of medicine, also published in 1947, by Cecilia C. Mettler is distinctive, since it is arranged by subjects instead of in the usual chronologic form. Both are fundamentally reference books, although they cannot always be relied upon for bibliographic details. Other books of more than passing interest published in 1947 were: *The Development of Modern Medicine*, by Richard Harrison Shryock, an expanded text of a book first issued in 1936; *Studies and Essays in the History of Science and Learning*, issued on the occasion of George Sarton's sixtieth birthday in 1944, but delayed in printing by the war; *Nicolaus Pol Doctor 1494*, by Max H. Fisch; *The Doctor in Oregon*, by O. Larsell; and of particular interest to the Boston Medical Library, *Amiable Autocrat: A biography of Dr. Oliver Wendell Holmes*, by Eleanor M. Tilton,

a fine account of our first president, with many of the pictures and quite a few of the facts furnished by the Library.

Future

The Librarian plans to fill our space in the Deposit Library with little-used material in 1948. At the end of 1947 about a third of the shelves were in use. As a result some reorganization of our duplicate collection will be possible, but no major change can be considered until our additional stacks are in place. Personnel are to be added as soon as suitable persons can be found. Publishing projects are under consideration: an addition to Farlow's *History* covering the period from 1918 to 1948 might be a fitting volume or a catalogue of our sixteenth-century books, similar to our published list of incunabula. Our Golden Jubilee, moreover, will occur in 1950, for on Monday, October 18, 1875, in two ground floor rooms at No. 5 Hamilton Place, the Boston Medical Library began its reorganized existence, with Dr. E. H. Brigham in charge. At that time Dr. O. W. Holmes was the president, and Dr. J. R. Chadwick the librarian.

Henry R. Viets

MEDICAL PROGRESS

PHYSIOLOGY*

Hebbel E. Hoff, M.D.,† and H. J. Scott, M.D.‡

MONTREAL, CANADA

ON NOVEMBER 22, 1947, the *British Medical Journal*[1–4] celebrated with a special issue the ninetieth birthday of Sir Charles Sherrington, whose *Integrative Action of the Nervous System* had been reprinted earlier in the summer as a feature of the seventeenth International Physiological Congress, the first to be held since the end of the war.[5] Both were gracious tributes to one of the great philosophers of the nervous system, a worthy member of that long and unbroken descent of scientific greatness represented by presidents of the Royal Society. Like that of Boyle, one of the founders of the Society, his philosophy has been anchored in the day-by-day experience of his laboratory, and theories, built on experiment, served to direct the experimentation of the next day, for, as Boyle said, these matters "should not be barely asserted, but explicated and proved."[6] Few neurophysiologists have been a part of so many of the fundamental movements in their field; we can except only Galen perhaps, who was its founding father, for Sherrington saw more clearly than any that the simple reflex, with its afferent and efferent arcs keeping action always under control of environment, furnishes the clue to the operations of the complicated region of the nervous system, where always the basic connection of afferent and efferent, sensory and motor functions is continued. Thus Sherrington was the great master of the reflex, and no one has surpassed him in his description of its nature and in biologic purposiveness; in fact Sherrington has brought to a close a whole era in neurophysiology, that of the reflex. Standing thus at the end of one classic development he participated equally importantly in the beginnings of two others: the study of cortical function and the investigation of the intimate physiology of unitary components of biologic patterns — indeed, it was in recognition of his investigation of the "single unit" that he shared with Adrian the Nobel Prize in Medicine in 1932. Finally, when the laboratory could no longer claim him, he has turned his rich experimental background to reflexions of "Man on his Nature,"[7] carrying out to the fullest extent the obligation of the physiologist to attempt always the synthesis of total and unit behavior — to explain the whole in terms of its parts.

So Sherrington has given a philosophy of neurophysiology, but he has furnished too the language and the tools of the work that lies ahead, as witness the happy phrase "synapse" and that inexhaustible source of experimentation, the decerebrate cat. Above all he has had the remarkable faculty of transmitting to others something of his own outlook. In no small measure this has been because of his acute sense of historical perspective, his willingness to learn from Aristotle and Galen, Fernel and Descartes, Marshall Hall and Goltz, and his ability to frame his own work against the background of the past. Few are the centers of neurophysiology where his pupils, or his pupils' pupils, are not to be found, and none where his influence has not reached. It is not inappropriate therefore to review some of the more significant advances in neurophysiology, in which his influence may be seen at work.

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The Nature of Reflex Action

Sherrington was one of the first to appreciate the significance of Cajal's first studies with his new modification of the silver-staining technic; the whole of his reflex doctrine is based on the assumption of the validity of the neurone doctrine that Cajal established. This lack of protoplasmic continuity between neurones focused attention on the point at which one axon establishes communication with another neurone, and so important did this region become that he established a name for it — the synapse. To him the fundamental characteristics of reflex behavior stem from the particular physiology of the synapses, and their anatomic pattern. Here there developed states of excitation or inhibition, "C.E.S." and "C.I.S.," whose algebraic sum determined whether the neurone discharged or remained silent, and he determined with care their time courses in several reflexes. But although electrical recording was not neglected at Oxford (the string galvanometer had been enlisted early as an aid in the precise timing of muscular contraction), it has remained for his pupil Eccles to make the most complete study of the intimate nature of synaptic transmission in simple reflexes.

Sherrington[8] described the reflex as follows:

> There is the co-ordination which a reflex action introduces when it makes an effector organ responsive to excitement of a receptor, all other parts of the organism being supposed indifferent to and indifferent for that reaction. In this grade of co-ordination the reflex is taken apart, as if separable from all other reflex actions. This is the *simple reflex*. A simple reflex is probably a purely abstract conception, because all parts of the nervous system are connected together and no part of it is probably ever capable of reaction without affecting and being affected by various other parts, and it is a system certainly never absolutely at rest. But the simple reflex is a convenient, if not a probable fiction.

Almost precisely in this sense has Lloyd[8, 9] defined the simplest of all reflexes, the proprioceptive stretch reflex. This reflex has its simplest expression in the knee jerk in the "spinal" man or animal; in a more highly developed form it is the fundamental component of reflex standing. Many earlier physiologists had indeed doubted that the knee jerk was in fact a reflex; its extremely short latency seemed to preclude this possibility.[5] Measuring the central latency of the reflex, Lloyd found that it was in fact so short that impulses entering via dorsal roots must have elicited a response in the ventral-horn cells without the mediation of an internuncial neurone. The stretch reflex is thus the simplest of all reflexes, involving only the direct influence of receptor upon effector neurones. This simple reflex is, however, organized, anatomically and physiologically, in relation to reflexes from other muscles acting at or across the same joint, reinforcing and being reinforced by some, and inhibiting and being inhibited by others, to form a functioning whole, which is the unit of biologic organized activity, the myotatic unit.[9]

Eccles[10–13] has recently summarized the evidence that at a variety of regions of anatomic discontinuity, such as in the synapses of the sympathetic ganglions, at the somatic myoneural junction and at the synapse of the spinal reflex, transmission occurs by virtue of the electrical influence exerted by activity in the presynaptic tissue upon the structure on which it impinges. Studying the electrical behavior of these structures under normal circumstances and when transmission is diminished or suppressed by appropriate drugs, such as curare in the neuromuscular junction and deep anesthesia in the reflex, Eccles has found evidence for the postulate that the passage of the impulse down the terminal portions of the presynaptic fiber causes flows of current in and out of the postsynaptic membranes that act precisely as an externally applied electrical stimulus. As the impulse first approaches the synapse in the presynaptic fiber it creates across the junction a momentary anelectrotonus, or the state produced at the positive pole of an external current applied to the tissue. This anelectrotonic state momentarily depresses the excitability of the postsynaptic tissue and delays its eventual response. It can account almost entirely for the phenomenon of synaptic delay. As the impulse in the presynaptic fiber reaches and occupies the whole of the synaptic expansion, the current is reversed and flows from the immediately adjacent postsynaptic membrane into the activated region of the synapse. This creates in turn at the postsynaptic membrane a catelectrotonic focus, which spreads exponentially over the surface of the neurone; out of its most intense area there grows a local response of the neurone. If by virtue of the concentration of synaptic endings the catelectrotonic focus is large enough in area and intense enough in degree, out of it or out of the local response itself there can develop a full blown action potential that will sweep over the excited cell. If neither the local response nor the exponentially propagated electronic potential is large enough to set up a propagated impulse, the slowly decaying potential will nevertheless alter the threshold of the neurone so that a second impulse arriving at that or nearby synapses and in itself incapable of creating a propagated impulse in a resting neurone might find the threshold now low enough to evoke a response. This is the basis for summation.

In the recent studies on the mechanism of central inhibition that Brooks and Eccles[11, 13] have carried out, one sees "a return to the original concept of Sherrington, that there are converging on motor neurones two sets of impulses, those exciting and so tending to cause the reflex discharge of impulses and those directly opposing this influence." This concept is a necessary consequence of Lloyd's demonstration that the stretch reflex involves only a two-neurone arc, for since this reflex can be inhibited by appropriate afferent stimulation, such

inhibitory activity must be exerted at the motor neurone or its synapses. The latency of inhibition of the two neurone arcs is, as Lloyd has shown, extremely short, no more perhaps than a millisecond. This demands in turn that the central pathways for such inhibition must be in themselves very short. To cover these requirements Brooks and Eccles have recently brought forward a novel and most ingenious electrical hypothesis of central inhibition that forms a logical counterpart to Eccles's electrical theory of central excitation. According to this hypothesis the inhibitory volley operates by subliminally stimulating an internuncial cell sending a short axon to the motor neurone to be inhibited. On the soma of the internuncial neurone will be created a local synaptic potential that will act as a sink into which current will flow from the axon and inactive areas of the soma and dendrite of that cell. There will therefore be a considerable outflowing current from the synaptic ending of the axon of this cell, which will in large part penetrate the postsynaptic membrane of the motor neurone. There it will produce a localized region of anelectrotonus, and as a result the excitability of the region will be depressed. One may now assume (and there are good histologic grounds for so doing) that the surface of the motor neurone is liberally covered with hundreds of synaptic endings, and postulate that inhibitory endings are more or less uniformly dispersed. If excitatory impulses are alone discharged the local responses will spread and fuse, generating the discharge of an all-or-nothing impulse. If, however, inhibitory impulses arrive simultaneously with or slightly before the excitatory impulses each excitatory focus will be surrounded by a zone of raised excitability, which will as it were isolate the excitatory influences and prevent their growth and fusion into a propagated impulse.

The Cerebral Cortex

Somatic Afferent Areas

Interest in the motor area of the cerebral cortex has been so keen and discussion over it has waxed at times so hot that the equally important function of the cortex as an afferent receiving station has at times been neglected. But those who have thought deeply of the plan of the central nervous system have seen in the development of the higher centers an opportunity for the renewal of the effective association of afferent and efferent fibers that forms the plan of the simple reflex arc. Walshe[14] wrote of this:

> There we have presented to us a conception of the nervous system in which the entire edifice is reared upon two neurones, the afferent root cell and the efferent root cell. The two form the pillars of the fundamental reflex arc and on the junction between them are superimposed, mediately or immediately, all the other neural arcs, even those of the cerebral cortex itself.

As Adrian[15] stated, "purposive acts, therefore, must be moulded like the movements of walking, by the controlled afferent patterns which are set up as the act progresses." Sherrington[5] wrote:

> The reactions of receptor organs which respond to stimuli from a distance tend especially to have large cortical representation. These receptors tend more than others to control the skeletal musculature of the creature *as a whole*. The contribution made by the cerebral hemispheres to the solidarity of the motor creature is largely traceable to their bringing to bear on other reflexes the unifying influence of the reactions of the distance receptors. . . . Remembering these conditions it need not surprise us that the distance receptors more and more exert preponderant directive influence over the whole nervous system. To say this is to say no more than that the motile and consolidated individual is driven, guided, and controlled by, above all organs, its cerebrum. The integrating power of the nervous system has in fact in the higher animal, more than in the lower, constructed from a mere collection of organs and segments a functional unity, an individual of more perfected solidarity. We see that the distance-receptors integrate the individual not merely because of the wide ramification of their arcs to the effector organs of the lower centers; they integrate especially because of their great connection in the high cerebral centres. Briefly expressed, their special potency is because they integrate the animal through its brain. The cerebrum itself may be indeed regarded as the ganglion of the distance-receptors.

So too, indeed, thought Descartes, who neglected the spinal cord as a mere bundle of nerve fibers and placed the whole of reflex activity in the cerebrum. Here began all the motor nerves of the body and here were projected all the sensory fibers (according to Descartes a single fiber could, of course, perform both motor and sensory functions; its motor through the flow of animal spirits in its hollow axis cylinder, and the sensory by a fibril running in the core of the fiber). These were so arranged that their spatial pattern within the brain reproduced the spatial distribution of the receptors from which they originated, so that as he wrote of the eye, "if we see any creature come toward us the light reflected from his body paints two images, one in each eye and these two images beget two others by intercourse of the optic nerves in the interior superficies of the brain that look toward its cavity." The demonstration of the histologic basis for such point-to-point projection from retina to cortex constitutes one of the triumphs of neurohistology. Recently, however, the method of physiologic neuronography has been applied to the afferent projection systems, particularly by the group at Johns Hopkins, where Woolsey[16, 17] and a series of collaborators have meticulously traced pathways of action potentials set up by the natural stimulation of some isolated peripheral receptive zone. On the basis of these studies it is now possible to make cortical maps of somatic afferent representation of the body surface and of acoustical representation in the auditory area that show precise point-to-point representation. In 1941 Adrian[18, 19] reported studies of a similar nature that have opened up a completely new aspect of

the problem of cortical localization. He found that a representation of different parts of the body's surface could be mapped out on the sensory area and that in general the receiving area of the cortex is concerned with parts of the body surface that are most closely related to the outside world. Thus, in the rabbit the mouth parts and in the cat the claws and the dorsal and lateral aspects of the forelimbs are most importantly represented; the face area is large in the dog, and the representation of hand and face important in the monkey.

Most significantly, however, Adrian found that the digits of the cat had a double representation, impulses from the claws and the ventral side of the toes appearing in a second area lying posterior to the face and extending back into the ectosylvian gyrus. A similar double representation has been found in monkey and man.[20] The somatic area I is of course the previously recognized afferent area in the postcentral gyrus of man and its homologue in other mammals. Somatic area II in the monkey lies on the upper back of the sylvian fissure between the auditory areas of the lower sylvian banks and the face subdivision of somatic area I. It is significant that the pattern of representation of body surface in the postcentral gyrus coincides closely with the pattern for distribution of motor points in the precentral gyrus. Representation in the second sensory area is not so precise, the largest responses being produced by stimulation of the extremities of the limbs, the snout and the tail of the monkey. Both contralateral and ipsilateral representation is found, the former being about twice as strong as the latter. There is differentiation of face, arm and leg centers within this area that overlap extensively in the rabbit, less so in the cat and least in the monkey. There are data to suggest that the two areas have separate projections into the cortex although they are apparently interrelated at the cortical level in addition. Rassmussen and Penfield[21] have surveyed over three hundred and fifty stimulation records in man to find 8 patients in whom the presence of a second sensory area would account for unexpected responses for which there was previously no explanation. In these patients subjective evidence of sensation was elicited when the brain was stimulated at the foot of the sensory motor strip just above the sylvian fissure.

Woolsey and Walzl[16] and Ades[22] found a second auditory area lying immediately ventral to the primary auditory cortex in the cat. A point-to-point projection of the cochlea was found in the primary projection area, each cochlea being represented bilaterally in the primary projection area with approximately equal ipsilateral and contralateral representation for each cochlea. The focal area for the basal end of the cochlea was found at the upper end of the anterior ectosylvian sulcus, with the apical end of the cochlea represented just behind the upper end of the posterior ectosylvian sulcus. The second auditory area lies immediately ventral to the primary auditory cortex, but it is organized in a pattern inverse to that of the primary system with the basal end of the cortex represented caudally and the apex rostrally. Finally, evidence for double representation of vision has also been presented.

Clues to the significance of this re-representation of the three major sensory areas have not yet been found, but Woolsey emphasizes the fact that it appears to be a fundamental principle of organization in other spheres. He points out that there is evidence that the cerebellar receiving areas are also double, that there are apparently slow and fast groups responsible for conduction of pain, that, as Adrian[23] has shown, the electric response of the human eye to the flash of light can be divided into a rapid and a slow component, and that, as pointed out below, a re-representation of the motor area also exists. It is obvious that these studies open up a whole new field for investigation; the detailed analysis of the relations of these areas to each other by direct intercortical communications or through corticothalamic associations has been started[24, 25] and gives promise that the future will see an understanding of the association of afferent and motor systems at the cortical level with a degree of completeness that now characterizes the interaction of these two systems at the simple monosynaptic reflex level.

Cortical Control of Posture and Movement

Sherrington's discovery of decerebrate rigidity brought into relief the concept of levels of integration developed by the clinical neurologists, according to which the developmentally higher centers were capable of inhibiting as well as exciting spinal-reflex centers. Damage to higher centers resulted not only in a deprivation paralysis of some functions but also in release-phenomena from discontinuance of the normal braking action. The continued validity of this concept finds expression in modern as well as in the older literature — for example, in the observations of Wang and Lu[26] on the development of the tadpole. These authors observed that the first integrating mechanism to develop in the tadpole is a spinal system for repeated reaction to a single stimulation. Somewhat later there developed in the rostral half of the hind brain a center that inhibits the spinal mechanism, reducing its spontaneous activity and limiting the reaction from external stimulation to a short response instead of the prolonged response of an earlier stage.

The many similarities between decerebrate rigidity and spastic states in man following lesions within the central neuraxis have encouraged the hope that from closer analysis of decerebrate rigidity in animals, clues might be found to the

pathologic physiology of the human conditions. Recent studies bring this objective much closer to realization. The first of these is the discovery by Magoun and Rhines[27] of an inhibitory mechanism in the bulbar reticular formation. Stimulation within the reticular substance lying ventromedially in the lower part of the bulb was found to inhibit spinal-cord reflexes and decerebrate rigidity and induced cortical motor responses. Such inhibition was bilateral from either side of the reticulum, although at lower thresholds some ipsilateral inhibition could be identified. A variety of evidence showed that this bulbar-depressor center probably receives activating impulses from a suppressor area (4 S) of the cortex, from the cerebellum and from the basal ganglions.[28]

Further work by Bach and Magoun[29] confirms the impression gained by earlier experimenters that much of the facilitation of the stretch reflex that is responsible for decerebrate rigidity descends to the spinal cord via the vestibulospinal tract and originates in the vestibular nuclei. But Rhines and Magoun[30] find that another important source of facilitation descends by a more laterally lying tract from a widespread center for facilitation extending from the thalamus, the sub-hypothalamus, the central gray and tegmentum of the midbrain, the pontine tegmentum and the bulbar reticular formation. Stimulation in these regions facilitates the reflexes of the lower center and augments the effect of cortical stimulation.[30] In the decerebrate animal much of this region has been removed, leaving to the vestibular system the greatest responsibility for maintenance of decerebrate rigidity, but in the intact animal this newly discovered facilitatory center assumes greater importance, particularly in the facilitation of phasic movement. Rhines and Magoun point out that it is essential to recognize that this facilitatory area is the same that on more intense stimulation will yield motion. This motor system, in all probability, maintains the almost normal motor activity of the decorticate cat and permits even the decorticate infant monkey to maintain a simple type of locomotion and muscular activity.

Ward[31] has shown that in the "decerebrate" rigidity resulting from small doses of sodium cyanide or other agents, neuronal activity is suppressed first at the cortical level and then at successively lower levels as the concentration of the agent increases. By implanting electrodes in the bulbar suppressor center he has shown that decerebrate rigidity appeared at the time when failure of nervous activity in centers activating the suppressor region produced a deprivation paralysis of this center and thus permitted the unrestrained activity of the facilitatory center to be expressed in the appearance of decerebrate rigidity.

Taken as a whole these studies form a logical complement to those on stimulation and ablation of the premotor cortex and serve to establish the concept of a nonpyramidal projection system mediating complex reflex reaching and grasping acts, movements of neck and shoulder-girdle musculature, rhythmical movements of the lips and of the tongue, as in sucking and licking, rhythmical movements of the upper extremities, behavior pattern and patterns of progression as well as inhibition of posture and other reflexes of the spinal cord.[32] Discovery of these brain-stem facilitatory and suppressor regions permits an explanation of many states of atonia and diminution of movements seen in man and in experimental animals, such as the observations of Keller[33] demonstrating atonia rather than decerebrate rigidity after large lesions in the region of the pons, the fixed, immobile and mask-like facies seen in the monkeys with hypothalamic lesions observed by Ranson,[34] the akinesia of cats with large caudal hypothalamic lesions observed by Bard[35] and others and the production of mutism or reduction of faciovocal activity after damage of the periaqueductal gray matter and tegmentum.[36, 37] All these may be interpreted as resulting from damage to brain-stem centers for facilitation. Most suggestive of the function of the bulbar suppressor center is the observation of Wagley[38] that a section of the reticulospinal fibers in the cord produces spasticity without paralysis.

This view of the function of the extrapyramidal system forms the logical counterpart to the concept of the pyramidal system as a predominantly motor apparatus, developed largely to mediate the control of skilled motion. This surely stems from Descartes, for although Galen recognized that the brain was the source of the spinal cord and the peripheral nerves, his more general concept was of the brain as a pool from which the animal spirit flowed to be distributed by the spinal cord acting more or less as an irrigation-distributing system. Descartes elaborated the hypothesis that the brain was linked to each muscle by isolated nerve fibers originating from the cavities of the brain in a spatial arrangement reconstructing the body. The mind or reflexes generally evoked motor response appropriate to the circumstances by opening these nerve endings to the animal spirits in the manner of an organist manipulating a keyboard. His concept was almost precisely that of Walshe,[14] who, arguing in quite the opposite direction, wrote as follows:

> It would seem therefore that we may look upon the pyramidal system as an internuncial, a common pathway by which the sensory system initiates and continuously directs, in willed movements, the activity of the nervous motor mechanisms. . . . The pyramidal system of itself initiates nothing and to speak of it as "responsible for" this or that category of movement is to ignore the force and motor power of its activities. It is simply the channel through which pass the impulse volleys by which willed movement is activated and continuously moulded by controlling cortical afferent patterns of excitation.

Willis[39] adopted much the same view from Regius one of Descartes' students:

> Moreover, as we have affirmed, that the Instinct for the performing of Motions is brought altogether through the Nerves from the Head to the Muscles, and as every Trunk of the same Nerve, being oftentimes broken into many shoots, variously distributing them, sends it to many destinated Muscles, it may very well be doubted how the animal Spirits, conveying the Symbol of the motion to be performed with a certain choice, do actuate only these or those branches apart from other branches of the same, and do not indifferently enter all the branches or shoots of the same; to wit; as the blood passes through the Trunk of the Artery, and all its ramifications equally. The most Learned Regius, that he might solve this knot, supposes in the Nerves some little doors, like to those which are found in musical Organs, the apertures whereof admit the Spirits to these or those parts especially, the rest being shut up. But he ought to have shewn, if not the little doors themselves, yet at least by what instinct and by whose direction sometimes these, sometimes those are locked up, and others opened. But in truth, this may rather be said, that all the shoots of the Nerves and lesser branches remain distinct and singular among themselves from the part to which they are inserted, even to their beginnings; so that a peculiar tract of Spirits or way of passage lyes open, from the Brain and its medullary Appendix, to every Muscle and nervous part; for in truth, although the Nerves, according to their beginnings, may seem to arise from the greater Trunks; yet it will easily appear, if you shall open the trunk of those branches, that in them many little Nerves, only like hairs, for the sake of a better conduct, are collected together in the same bundle; yea, the coverings being separated, you may follow oftentimes the little Nervulets, and those single to the respective parts and members, to which they are destinated.

More than anyone else it has been Sherrington who has been responsible for the development of a modern hypothesis of punctate localization by his repeated demonstration of the response to cortical stimulation and by publication of maps showing a regional representation of the body musculature in the precentral gyrus. It was obvious to Sherrington[40] that "the individual movement, elicited by minutely localized stimulations are, broadly speaking, fractional in the sense that each, though co-ordinately executed, forms, so to say, but a unitary part of some more complex act, that would, to attain its purpose, involve combination of that unitary movement with others to make up a useful whole." Sherrington concluded that the cortex is not merely a selector of patterned movements established at lower levels but a center for the integration of afferent and efferent impulses where both are represented in minute degree and where the possibilities for the interaction of the two are vastly expanded:

> The large variety of partial, though discrete and in themselves perfect, movements of separate portions of the bodily framework, evocable by localised point-to-point stimulation of the motor cortex, and the multiform combinations which these assume under cortical reaction and the right mutual associations of the cortical motor points which the physiological phenomena of "facilitation" and "deviation of response" reveal, are suggestive. They lead to the supposition that from movements of locally restricted parts — e.g., movements of a finger or a limb-joint (movements themselves discrete and individually separable in the motor cortex) — the upbuilding of larger combinations varied in character and service able for purposes of different and varied kind, prehensile, defensive, locomotor, mimetic, masticatory, deglutitional, orientational (in von Monakow's sense), etc., is one of the main offices performed by the motor cortex. The functional properties of this cortex seem specialized for that end. It appears at first sight surprising that a motor nervous organ relatively so high as is the cerebral cortex in the nervous hierarchy, where the power to deal with large integrated complexes of the motor machinery might be expected, exhibits on actual examination a representation, still more or less discrete, of relatively small and "partial" movements. And in the motor cortex this discrete "representation" of small local items of movement, each highly co-ordinated with others yet separably elicitable, instead of becoming less evident with ascent to the higher types of hemisphere, becomes more so. Thus, it is more evident in cat and dog than in rabbit, more evident in the Macaque than in cat or dog, in baboon than in Macaque, in gibbon than in baboon, and in the chimpanzee, orang, and gorilla than in gibbon. It would seem that in order to preserve the possibility of being interchangeably compounded in a variety of ways successive or simultaneous, these movements must lie, as more or less discrete and separable elements, within the grasp of the organ which has the varied compounding of them. To draw an analogy merely illustrative, the synthesis of the proteins of the body requires that certain metabolic organs must have, lying at their hand, the numerous amino-acid constituents of proteins; for that purpose the food proteins, split up into constituent chemical subgroups, more or less freed one from another, are presented to the synthetic organs for varied re-grouping in the re-synthesis which follows. The motor cortex appears to be par excellence a synthetic organ for motor acts. How does the motor cortex obtain these fractional and partial movements on which work its powers of varied synthesis? Simpler co-ordinated elements, such as flexion of a single joint — e.g., knee or elbow — can be safely assumed to lie ready to its hand in the bulbo-spinal mechanisms. But the higher of the compounded movements which those mechanisms give tend, if judged from the spinal and decerebrate dog and cat, to be compounds exhibiting total flexion or total extension of a whole limb. In the limb movements evoked from the anthropoid motor cortex, flexion of one joint may go either with flexion or with extension of another. The motor cortex may therefore obtain the partial and fractional movements it so variously weaves together by, to a certain extent, breaking up compounds already constructed by lower centres. Such analytic power may be a property of its own, or of some other, perhaps subcortical, organ with which it keeps close touch. Such synthesis involves time adjustments as well as spatial adjustments. The bulbo-spinal axis also, of course, synthesises motor acts. But the difference between the constructive planes of the two is considerable. Bulbo-spinal synthesis constructs in the main those locally restricted but co-ordinate movements which the cortical synthesis finds ready to hand as elements for it to work with. The bulbo-spinal organ taken as a whole does, even in types so high as dog and cat, synthesise in addition to the local elementary movements a not inconsiderable number of more complex ones, such as respiratory, defensive, and even locomotory. But comparison of the synthetic capacity of the bulbo-spinal organ with that of the motor cortex reveals a great excess of synthetic capacity in the latter, as evidenced by the variety and multiform scope of the motor acts and sequences it builds up. Especially is this so when it is borne in mind that many acts which, when naturally performed, are bilateral, are, when excited by stimulation of one motor cortex, essentially unilateral, indicating that the two motor cortices have to be regarded as in many respects a single organ when in natural operation. Together they form, in such an animal type as the anthropoid ape, an organ for synthesis of movements — and of postures — on a vast scale. Phenomena, such as "reversal of response," "facilitation," and "deviation of response," prominent in cortical responses, and accounting for the functional instability of cortical motor points, are indicative of the enormous wealth of mutual associations existing between the separable motor cortical points, and those associations must be a characteristic part of the

machinery by which the synthetic powers of that cortex are made possible. The motor cortex seems to possess, or to be in touch with, the small localised movements as separable units, and to supply great numbers of connecting processes between them so as to associate them together in extremely varied combinations."

(To be continued)

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CASE RECORDS OF THE MASSACHUSETTS GENERAL HOSPITAL

Weekly Clinicopathological Exercises

FOUNDED BY RICHARD C. CABOT

TRACY B. MALLORY, M.D., *Editor*

BENJAMIN CASTLEMAN, M.D., *Associate Editor*

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CASE 34291

Presentation of Case

A fifty-eight-year-old woman entered the hospital because of a right-upper-quadrant mass.

One week before admission the patient had sudden onset of severe constant pain in the right upper quadrant, which lasted, diminishing somewhat in intensity, for two days and then disappeared only to return again quite suddenly two days before admission. This time the pain was severe enough to require morphine but lasted for only one day. With these attacks there were no chills, fever, nausea, vomiting or jaundice. There were no genitourinary symptoms or bowel symptoms either with the attacks or during the months before admission. However, during this period the patient noted a small weight loss of undetermined amount. For many years certain articles of diet such as Coca-Cola, ginger ale and sweets caused frequency of urination and burning, and "rich foods" caused indigestion. Seven years before admission, following an attack of right-sided pain, she was told that she had a kidney stone. Two years later, following a period of weakness and nausea of indefinite duration, a parathyroid tumor was removed at another hospital. At about the same time a non-functioning gall bladder was found by x-ray examination.

The patient's mother had died of carcinoma of the rectum, and a sister had died of carcinoma of the uterus.

Physical examination disclosed a well developed and well nourished woman, the important physical findings being limited to the abdomen. In the right upper quadrant there was a smooth, slightly tender, apparently cystic mass approximately 15 cm. in diameter, which appeared attached to the liver.

The blood, urine and stool examinations were within normal limits, as were the nonprotein nitrogen, total protein, calcium, phosphorus, alkaline phosphatase, prothrombin time, bromsulfalein test and cephalin-flocculation test. A blood Hinton

test was negative. An intravenous pyelogram showed a soft-tissue mass, 8 cm. in diameter, on the right side of the abdomen with apparently no connection to the kidney. There was good renal function, and no stones were seen. A barium enema showed the same mass in relation to the superior aspect of the transverse colon but not intrinsic in the colon.

On the eighth hospital day an operation was performed.

Differential Diagnosis

Dr. John B. McKittrick: May we see the x-ray films?

Dr. James J. McCort: The mass is present on the right side. Following a barium enema it is seen to cause a slight pressure defect in the region of the hepatic flexure. There is also a small diverticulum in this region, which is well demonstrated on the spot film. On the pyelogram one can see the mass extending below the inferior pole of the kidney and through the mass one can see the outline of the kidney clearly. There is no distortion or displacement of the calyxes or pelvis. The mass itself is smooth and shows no calcification.

Dr. McKittrick: The pain is characteristic of gallstone colic. It was severe, recurrent and in one instance required morphine. The patient did not have chills, fever or jaundice, and we have no evidence from the history that there was any inflammatory process going on. Indigestion is mentioned, but the history does not tell us how severe it was. This is significant in view of a later statement regarding a slight weight loss.

I believe that the urinary frequency attributed to Coca-Cola, ginger ale and so forth had nothing to do with the present episode. One cannot tell what the frequency means. The frequent passage of large amounts of urine after the ingestion of sugar should make one investigate the patient from the point of view of diabetes. In the past, she had renal stones, and five years later the removal of a parathyroid tumor. It would be interesting to know what prompted the search for the parathyroid tumor.

Dr. Benjamin Castleman: There is a letter from her doctor saying that he saw her because of a toxic thyroid gland. She was sent to the Peter Bent Brigham Hospital and seen by the late Drs. Elliott Cutler and Soma Weiss. Apparently, the parathyroid tumor was discovered in the process of thyroidectomy, so that I do not believe that she had symptoms of hyperparathyroidism.

Dr. McKittrick: I wondered if the history of kidney stones had stimulated the search.

Dr. Castleman: Dr. Soma Weiss thought that the vomiting was due to the toxic goiter.

Dr. McKittrick: The mass in the right upper quadrant was slightly tender, smooth and 15 cm. in diameter, and appeared to be attached to the liver. This means gall-bladder disease until proved otherwise. We are not given one item of important information about this mass: I would like to know whether it was fixed or movable and how long it had been present. The laboratory studies reported are negative. There is no bilirubin report, but I would anticipate this determination to be normal.

The only diagnosis that I can make is hydrops of the gall bladder. I am a little skeptical of this diagnosis because it appears too simple. Such a condition may develop painlessly; in fact, it usually does. It is due to obstruction by a stone in the lower end of the gall bladder or cystic duct, with distention of the gall bladder without infection. That is one reason why I wanted to know whether it was movable. The average hydrops is movable and may attain considerable size. In this case, there was enough tone left in the wall of the gall bladder to cause pain.

What should one consider in the way of differential diagnosis? There is always the question of carcinoma. I do not see how one can rule it in or out. The association of stones and carcinoma of the gall bladder is high, carcinoma of the gall bladder being almost always associated with gallstones. We have insufficient evidence, even with the weight loss, to make a diagnosis of carcinoma. Also, the diagnosis of carcinoma of the gall bladder is usually not made preoperatively, although at times one can legitimately suspect it. There are various lesions of the kidney that could present this picture, but they are fairly well ruled out by the preoperative examination. Apparently, in the mind of the attending physician, a lesion in the colon was also considered since a barium enema was done. It is entirely possible for lesions of the hepatic flexure to present themselves in this location and to appear to be fixed to the liver. We cannot rule out a lesion in the head of the pancreas. A cyst in the head of the pancreas can attain a large size and give the physical character of the mass described in this patient. I do not see how we can rule that in or out, but I do not believe the history is consistent with cyst of the pancreas.

Should we consider the common duct in our diagnosis? It is true that a large, distended gall bladder can occur in a patient with obstruction to the common duct in the absence of much or any jaundice. Usually, however, these patients have other symptoms that suggest common-duct disease, such as chills, fever and jaundice. A determination of the blood bilirubin would have helped in this regard.

The surgical service waited eight days to operate upon this woman. If my diagnosis is correct, she could have been operated upon much sooner. My diagnosis is stone impacted in the lower end of the gall bladder, with hydrops.

Clinical Diagnosis

Hydrops of gall bladder.

Dr. McKittrick's Diagnosis

Hydrops of gall bladder.

Anatomical Diagnoses

Carcinoma of gall bladder.
Cholelithiasis.

Pathological Discussion

Dr. Castleman: Perhaps the reason why the surgeon waited eight days was that the patient was sent in to Dr. G. G. Smith as a urologic problem and it took a few days to have the general surgeons see her. Dr. Richard H. Sweet examined her. The mass was smooth and tender and felt to him like a hydrops of the gall bladder. He did not believe it was kidney. At operation he found that the mass was a large gall bladder adherent to the omentum and also to the transverse colon, where one could see it pressing against the hepatic flexure. It was inflamed, had a red, thick wall and extended down into the bed. In removal a good deal of grumous material came out, and when the mass was opened, it was found to contain large numbers of stones. In freeing up some of the adhesions it was discovered that there were several nodular areas in a portion of the fundus, which to Dr. Sweet, looked suspicious of carcinoma. When finally examined, there were large, papillary-like masses projecting into the lumen of the gall bladder, which on microscopical examination proved to be an undifferentiated carcinoma. Several stones were present as well.

This case is interesting because seven years previously a Graham test had been positive. Had the gall bladder been removed at that time, I suppose that the cancer would have been prevented. Dr. Joel Goldthwait of our laboratory looked up the cases of carcinoma of the gall bladder that were found at autopsy, and out of 12,000 autopsies in adults, he found stones in 12 per cent, and 3 per cent of the cases with stones had carcinoma of the gall bladder. The usual statistics are between 3 and 5 per cent.

Dr. Jacob Lerman: What correlation was there between stones and cancer?

Dr. Castleman: Ninety-five to 98 per cent of cases of carcinoma of the gall bladder occurred in patients with gallstones. The incidence is very high and one wonders whether, if a patient shows a stone in x-ray study, the gall bladder should be removed. What is the experience of the surgeons? Do they always remove it?

Dr. McKittrick: That depends on the surgeon and the patient. I would have advised cholecystectomy in a patient with a pathologically obstructed gall bladder, which I assume she had seven years before admission. I should like to ask how many gall bladders are pathologic without stones. If stones are demonstrated, I think the gall bladder should be removed.

Dr. Castleman: The stones are not visible on the films in this case.

Dr. McKittrick: That is not unusual; even in a carefully done cholecystogram one may not see the pigment stones. That is why I wondered how often one sees a pathologic gall bladder without some form of concretion in it.

Dr. Castleman: I should say that most of the really diseased gall bladders have stones.

Dr. McKittrick: That is the clinical impression that most surgeons have.

CASE 34292

Presentation of Case

An eleven-year-old schoolboy was admitted to the hospital following attacks of acute spasmodic abdominal pain.

Five months previously he experienced a one-day episode of severe pain just below the umbilicus, coming in spasms and causing him to double up in bed. There was no nausea, vomiting or change in bowel habits. There were no chills, fever or bloody or tarry stools. Following this he resumed his normal activity with good appetite and no weight loss. Eleven days prior to admission the pain returned, and he was operated upon at another hospital. According to his mother, the appendix was not involved, but a "tumor of the cecum" was found and the operation was terminated without an attempt at resection. He convalesced uneventfully and was admitted to this hospital for diagnosis and treatment.

Physical examination was negative except for a recent right pararectus scar. No abdominal tenderness or masses were noted.

Examination of the blood showed 14.6 gm. of hemoglobin and a white-cell count of 8700, with 57 per cent neutrophils. A urinalysis was negative. A stool specimen was guaiac negative. A barium enema filled the colon readily from rectum to cecum. The terminal ileum was not demonstrated. The appendix was not adequately visualized in the pre-evacuation study but was well filled in the post-evacuation films. It was movable and not remarkable in appearance. Along the medial aspect of the cecum at about the level of the ileocecal valve there was an extrinsic pressure deformity about 2.5 cm. in diameter. This was best demonstrated with the patient prone.

On the fifth hospital day an operation was performed.

Differential Diagnosis

Dr. Leo Burgin: By virtue of the previous laparotomy a good deal of the wind has been taken out of my sails. Such every-day possibilities as an

acute appendicitis, with or without abscess, Meckel's diverticulum and mesenteric adenitis are tossed out. One is led at once to the site of the lesion — the vicinity of the cecum. Our possibilities are still further narrowed by the demonstration of "an extrinsic pressure deformity about 2.5 cm. in diameter." Rather than have some of our ideas dispelled at once by the roentgenologist, perhaps it might be better to proceed with the discussion and be refuted later by the x-ray films and Dr. Mallory.

The first episode of pain is not particularly helpful. It sounds like colic. Many a youngster has had such a bout of colic owing to functional rather than organic difficulty. I presume that this episode was elicited by whoever took the history and may or may not be referable to the existing disease.

The attack of pain eleven days before admission must have simulated appendicitis. A laparotomy was performed, and a "tumor of the cecum" was found. That the appendix continued to be normal is attested to by the subsequent x-ray films, which revealed a freely movable organ, well filled with barium. Certainly the deformity described, the absence of fever, the normal white-cell count and the negative physical findings are against infection in the sense of an abscess, or other inflammatory process.

Could a mesenteric lymph node be large enough and close enough to the cecum to give such a picture? Certainly nonspecific mesenteric adenitis occurs without fever or elevated white-cell count. The findings at the previous laparotomy are against such a hypothesis. I doubt that lymph nodes ever reach such a size. Perhaps the surgeons can enlighten us on this point. I suppose one ought to consider lymphoma — of the Hodgkin's type with enlarged lymph nodes. The absence of a prolonged history of nodes elsewhere, of anemia and of intermittent fever seems to rule out this possibility. A tuberculous adenitis (tabes mesenterica), especially if a number of lymph nodes were fused together, might give rise to a mass large enough to give the deformity shown by x-ray study. Pain is perhaps the most consistent complaint but need not be present. We have no information regarding the tuberculin test, nor is there anything to suggest tuberculosis elsewhere.

What of malignant tumors? Those inside the bowel would be associated with melena of varying degrees, anemia, loss of weight, nausea, vomiting and so forth. Cancer of the gastrointestinal tract is quite rare in childhood and when present is more likely to be in the rectosigmoid area. This patient presumably remained in good health after the first episodes of pain; cancer seems unlikely. The evidence offered is for a lesion outside the bowel. We may likewise rule out benign tumors of the gastrointestinal tract, adenoma, fibroma and so forth for those lesions would be expected to give rise to disturbed gastrointestinal function.

What about abdominal tumors outside the bowel? The most common malignant abdominal tumors in children are those connected with the kidney, such as embryoma, and those arising from sympathetic nervous tissue in the retroperitoneal space. These tumors occur earlier in life and are associated with an enlarged abdomen and palpable mass, usually in the flank in cases of embryoma; nodular masses are generally palpable in cases of neuroblastoma. The latter metastasizes early to liver, lung and bone. Signs of debility are generally present.

What other structures should we consider? Changes in the tissue adjacent to the cecum — the mesentery — might well be responsible for this picture. Bits of lymphatic tissue may become displaced in the mesentery and proliferate, and since no communication is available with the lymphatic system, cysts (so-called mesenteric cysts) are the result. These may occur anywhere in the mesentery either at the base or at the enteric border. Since they are not usually tensely filled, they tend to be flabby and, until they become large, may escape notice on abdominal palpation. In the typical case a painless, slowly enlarging abdomen is the only complaint. Symptoms of obstruction or abdominal pain may occur intermittently. Generally the cysts are large and freely movable. I can visualize such a cyst giving rise to this x-ray picture. However, because of its very flabby nature, one would expect an inconstant picture, which we assume was not present in the case under discussion.

There is another lesion that can arise in tissues adjacent to the cecum — or for that matter anywhere in the gastrointestinal tract. This is the so-called enterogenous cyst or, as such lesions are often called, duplication of the alimentary tract. Small outpocketings of intestinal mucosa occur regularly in the fetal alimentary tract. Some of these may fail to regress and become pinched off and give rise to an adjacent duplication. These duplications then secrete to a varying degree, sometimes to the point of pressure necrosis. In contradistinction to mesenteric cysts, these duplications are firmly adherent to the intestine and usually have a smooth-muscle coat of more than one layer. They may be large enough to be felt by palpation and often give rise to symptoms of colicky pain, partial obstruction and visible peristalsis. The pain may arise from distention secondary to excessive secretion within the cyst. Occasionally they press upon mesenteric vessels as they lie within the leaves of the mesentery and give rise to sloughing or bleeding of adjacent bowel. On the other hand, they may not give any symptoms for long periods. In fact Ladd and Gross* report the incidental finding of a 1.2-cm. duplication of the

* Ladd, W. E., and Gross, R. E. *Abdominal Surgery of Infancy and Childhood.* 455 pp. Philadelphia and London: W. B. Saunders Co., 1941. P. 83.

terminal ileum in a nine-year-old child operated on for appendicitis.

In the present case we have evidence of a lesion intimately associated with the cecum in a boy of eleven who appeared to be well otherwise. The lesion was responsible for colicky pain on at least two occasions. In the course of laparotomy it is described as a tumor of the cecum. I believe this lad had a duplication of the cecum.

May we see the x-ray films?

DR. STANLEY M. WYMAN: The barium-filled colon on the large film fails to reveal the lesion described, but after evacuation there is a faint suggestion of irregularity of the cecum medially. The films taken during examination show a continual demonstration of a filling defect on the medial wall of the cecum. The fluoroscopist believed that this changed somewhat in contour during examination. This spot film taken after barium shows a faint suggestion of lobulation in that area. The ileocecal valve is not filled on any film so that one cannot say whether this is the ileocecal valve or the region adjacent to it. The well filled appendix is seen in this film and appears normal. The fluoroscopist's impression was that the mass was entirely extrinsic, but I think it is hard to exclude the possibility of an intramural lesion pressing on the lumen of the bowel.

DR. BURGIN: The note said in effect that the deformity was better visualized when the patient was prone, suggesting that the weight of the lesion itself gave rise to it. That would be more evidence for a lesion outside rather than inside the bowel.

DR. WYMAN: I was not sure about that statement, and I asked the fluoroscopist about it. He was not entirely certain in retrospect that that was so.

DR. BURGIN: Since the patient had very little in the way of symptoms referable to disturbed function within the gastrointestinal tract, I am going to stick to my original diagnosis of enterogenous cyst of the cecum.

CLINICAL DIAGNOSIS

Benign tumor of cecum.

DR. BURGIN'S DIAGNOSIS

Duplication of intestinal tract.

ANATOMICAL DIAGNOSIS

Duplication of intestinal tract (terminal ileum).

PATHOLOGICAL DISCUSSION

DR. RICHARD H. SWEET: I was called upon to perform the second operation in this case. The surgeon who performed the first operation is a competent surgeon in western Massachusetts but a close relative of the patient who decided against doing radical surgery on a member of his own family. When I talked with him and reviewed the history the picture seemed most suggestive of intussusception of a transitory nature that relieved itself spontaneously. The surgeon described the tumor quite accurately as being very soft and having little substance. When I felt it, it was obviously not mesenteric adenitis. One could see normal lymph nodes. The appendix was free and uninvolved. The tumor felt as though it were part of the wall of the cecum, although it was very soft. Only when I removed it and had a chance to dissect the mesentery off a little bit and looked more carefully was I certain of its nature. I thought it was a soft, polypoid lesion of the bowel itself, but we performed a rather limited resection, removing the cecum and a portion of the terminal ileum.

DR. TRACY B. MALLORY: The specimen removed showed a cyst, lying within the wall of the terminal ileum in immediate apposition to the ileocecal valve, with a relatively small internal diameter (7 mm.), which was included in the muscular layers of the ileal wall. The content of the cyst was a pure mucous fluid, and the lining was quite smooth and looked like intestinal mucosa. That was confirmed microscopically. This is, I think, a very clear example of a so-called duplication of the intestinal tract. It was a small lesion that produced symptoms rather later in life than usual, probably because it remained so small. We thought at the time of examination that there was a slight degree of intussusception through the ileocecal valve. Dr. Sweet perhaps had a better chance of determining that than we had.

DR. SWEET: I could not be sure. It was obvious that it lay somewhat above and posterior to the ileum. I was surprised to learn that it was part of the ileum. It seemed to me that it was part of the cecum. There was no intussusception at the time of operation or at the time of the previous operation.

DR. MALLORY: An intraluminal tumor is a very common cause of intussusception. A tumor exterior to the lumen of the bowel causes intussusception less frequently, but nevertheless could be a primary basis for intussusception or volvulus.

DR. BENJAMIN CASTLEMAN: How else would you account for the colic, Dr. Sweet, unless there was a degree of intussusception in the past?

DR. SWEET: I am sure that is what this patient had. There is no other way to explain it — no inflammatory reaction and no narrowing of the bowel. The only way I could explain the obvious small bowel colic was that the bowel had become intussuscepted.

DR. CASTLEMAN: Is that what Ladd and Gross say?

DR. BURGIN: They mention distention of the cyst as a cause of pain. Of course these cysts are usually larger than the one described here. One in a lad seven or eight years of age, who I remember never to have had symptoms, was 1.5 cm.

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ACRES, MEN AND NUTRITION

A BROADER view of nutrition appears to be just around the corner. Although the Citizen's Food Committee long since abandoned the eggless Thursday and the meatless Tuesday, there is beginning awareness of a broader exchange of energy than that which exists between the A & P and the kitchen stove.

Dr. Fredrick J. Stare, in a recent issue of the *Atlantic Monthly*, calls attention to the fact that both meat and eggs must trace their energy origins to botanical processes, and that growing things in turn receive their energy from the sun, storing it in a convenient system based on the reversible oxidation of carbon.

Dr. Stare provides a table showing the number of acres of fertile land required to produce 1,000,000 calories of various foods. We see, for instance, that 1,000,000 calories of sugar requires 0.15 acres, as contrasted with 1,000,000 calories of beef, which requires 17.0 acres, of "fertile land." These figures are valuable, the concept is fundamental, and we are further indebted to Dr. Stare for the important work in nutrition that is being conducted at the Harvard Nutrition Laboratories under his able direction. Similar comparisons are to be found in the paper by Talbot and his associates published elsewhere in this issue of the *Journal*.

But are we not further forgetting the already forgotten man? The system of energy exchange that starts at the sun and ends with photosynthetic products on our tables (or in the mouths of Europe) involves another energy investment besides that of the sun's rays and the raw materials contained in the acres of fertile land. It is the energy of the working man who produces the food.

A contrast between the potato at 0.44 acres per 1,000,000 calories and the steer at 17 acres per 1,000,000 calories is instructive. Aroostook County farmers can tell a good deal about the energy required to raise an acre of potatoes. Each potato must be planted individually, cultivated, hoed, weeded and finally harvested by back-breaking effort. There may be machines that do this in 1948, but this argument considers the energy put into the potato patch by the men who work it rather than the energy from gasoline (even admitting that the products of the gasoline station also trace their origins back to plant life and solar energy). In the transport of the food energy of that potato from the seed to the table there is an expenditure of energy on the part of men — energy that the men in turn have received from other botanical products. In Aroostook County this manpower probably traces itself back to potatoes in large part, and it has been re-expended to harvest more potatoes.

A shift of attention to the steer reveals that the steer's mother, the cow, does most of the hard work. The bull, it is true, plays a brief but important role, thereafter disporting himself about the pastures in a carefree manner. After the calf is born he lives on his mother's milk for a few months, and the only other energy from animate sources that goes into raising him further comes from the energy expended

by a few horses in rounding him up and branding him, and then putting him into a weaning pen in the fall. Cowboys think they work hard, but most of us would gladly trade jobs with them — the horse donates most of the foot pounds. During the ensuing winter some man energy is expended in feeding the steer hay while the snow is deep. The following summer his own legs carry him up into the mountain ranges, where he stores away all the NH_2 groups and peptide linkages that are later recognized as beefsteak. Finally, a horse carrying a rider gathers him and his fellows together and takes them to the railroad, where the oxidation of carbon as coal (or oil) carries them to the stockyards. The energy of transforming him from a steer to a beefsteak is a complicated problem of industrial work, but it probably finds its analogue in Aroostook County through the sorting, grading, cleaning and sacking of the potato.

Furthermore the steer has availed himself of grass growing on land that generally cannot be used for anything else. If the steer does not eat the grass it is eaten by wild animals or else it goes to seed. If the steer eats it after it is ripe many of the seeds go through him unchanged and undigested but will grow new grass on the same pasture. In essence, although the steer meat requires 17 acres for 1,000,000 calories as opposed to the 0.44 acres for 1,000,000 calories of potatoes, that is not the whole story. There is in addition a difference in the energy expenditure required to produce the food in edible form and a wide discrepancy in the types of land that must be used to produce the two foods. Even though it requires 17 acres to produce 1,000,000 calories of beef it is quite conceivable that this amount of beef is produced with the expenditure of fewer calories than the 1,000,000 calories of potatoes and with considerably less depletion of the earth's resources. It thus becomes apparent that the gross figure of acres required to produce food does not wholly cover the subject of planning the economy of the United States or, indeed, that of the world. If 1,000,000 calories of good protein is to be obtained in the most efficient way all the other energy in-put factors must be measured, weighed and carefully accounted for.

SHERRINGTON'S CLASSIC CONTRIBUTION TO NEUROPHYSIOLOGY

LAST November 27, Sir Charles Scott Sherrington, dean of the world's physiologists, Nobel Laureate and author of *The Integrative Action of the Nervous System* (1906) quietly celebrated his ninetieth birthday. Sir Charles was very much alive, and the Physiological Society of Great Britain even more so, for they republished his famous monograph[1] — referred to by the author as "my rather elderly book" — and saw to it that appropriate notices appeared in the *British Medical Journal* and the *Lancet*. Best of all, Sir Charles wrote a "Foreword to 1947 Edition," as brilliant a piece of writing as ever came from his pen — thoughtful, meaty, with a meticulousness of style long familiar to his devoted followers, whose contact with him in recent years has been largely through *Man on his Nature* (1940) and *The Endeavour of Jean Fernel* (1946). In crisp sentences he deals with some ambiguities that have arisen since 1906 and turns from the simpler forms of reflex behavior:

> The field of the psyche is entered. An old adage has it that to the trodden worm its own trodden self is the world's greater half. That anthropomorphic worm may typify ourselves to us; the "self" of each of us goes far to epitomize the integration we are now to look at. We can retain the scheme of spatial nervous arrangement we used before, this time, however, not mutilating the central organ, but keeping the animal — the human animal if you will — intact. The receptors at the starting-points of the nerve-thread we find now to be, by conspiracy with a psyche in the central organ, sense-organs. The full panel of the "five-senses" is in session, and by further collaboration with the psyche, a world of subject and object for the individual is in being. The individual has attained a psychical existence. Phases and moods of mental life accrue. Each waking day is a stage dominated for good or ill, in comedy, farce or tragedy, by a *dramatis persona*, the "self." And so it will be until the curtain drops. This self is a unity. The continuity of its presence in time, sometimes hardly broken by sleep, its inalienable "interiority" in (sensual) space, its consistency of view-point, the privacy of its experience, combine to give it status as a unique existence. Although multiple aspects characterize it it has self-cohesion. It regards itself as one, others treat it as one. It is addressed as one, by a name to which it answers. The Law and the State schedule it as one. It and they identify it with a body which is considered by it and them to belong to it integrally. In short, unchallenged and unargued conviction assumes it to be one. The logic of grammar endorses this by a pronoun in the singular. All its diversity is merged in oneness.

Furthermore, "the body-mind liaison provides in a largely physical world the physical means of giving

expression to the psychical" and "each of the two achieves its aim only by reason of a *contact utile* between them":

> And this liaison can rank as the final and supreme integration completing its individual. But the problem of *how* that liaison is effected remains unsolved; it remains where Aristotle left it more than 2000 years ago.

As Fulton[2] notes: "To the most profound student of the nervous system the world has yet known, the mind of man remains still unexplained."

Many will believe with Fulton that the problem is not quite where it was two thousand years ago, thanks to the researches of the former Waynflete Professor of Physiology at Oxford. Sherrington has at least pointed the road that will one day lead to an answer to this age-old question. Others,[3-7] moreover, took advantage of Sherrington's birthday to express similar sentiments.

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CONGRESS LOOKS AT HEALTH

It was perhaps inevitable that in anticipation of a national election there emerged a small avalanche of legislation related to matters that might be issues in the campaign.

There seemed to be no profit for any political party in the forwarding of such major projects as the Wagner–Murray–Dingell Bill or the Taft Bill, both of which were killed. The National Science Foundation Bill (S. 2385) finally failed of adoption, although in principle this seemed to be the proper approach toward solution of the part Washington should play in helping the earlier realization of actual and potential values made available by the several groups in the field of science.

The medical parts of the program — for example, those relating to research and control in diseases of the heart and circulation — will be less well forwarded by such a bill as S. 2215 (the National Heart Bill), and scientific advance will not be as well integrated by it. This bill, introduced by Senators Bridges, Pepper, Ives and Murray, as specialized legislation aimed at meeting needs only in a single field, important as they are, was finally adopted with amendments.

Many people believe that infantile paralysis has absorbed too large a proportion of public funds for the needs or accomplishments, when comparison is made with the much higher morbidity and mortality of circulatory diseases. Perhaps it is not surprising that some of the cardiologists who felt this disproportion keenly were strongly behind specialized legislation for their own interests, whereas other wise cardiologists, perhaps with larger perspective, preferred to take their chances with a much more comprehensive kind of legislation like the National Science Bill. Some there are who believe that there is no need for federal legislation in these matters. There seems, however, to be general agreement that all-over co-ordinated scientific investigation would accelerate the finding of needed truths that seem just beyond the horizon.

Scientific research under governmental organization was performed so successfully in wartime that we may hope to see the thread picked up again. Compromise is necessary in legislation, but compromise with loss of larger obtainable values represents a shortsighted policy.

KICKBACKS KICK BACK

Blinded, no doubt, by the bright sunshine of the brilliant land in which they practice their art, an impressive number of the physicians of Los Angeles County seem unable to have read with understanding the Principles of Medical Ethics of the American Medical Association. Ironically, this visual incapacity has had to do with the receiving of rebates or "kickbacks" on eyeglass prescriptions from the local purveyors of these optical adjuncts.

For eight years efforts from within the medical profession were of no avail in putting to an end this lucrative by-product of a professional activity otherwise not without honor. Eventually, however, the Los Angeles Better Business Bureau, aided by the *Reader's Digest* and the backing of the Los An-

geles Radiological Society, succeeded in achieving a degree of publicity that, while it reflected no credit on a considerable number of physicians who perhaps had not heard of the Hippocratic Oath, nevertheless waked the "organized profession" into action.

Let us hope that clean glasses will aid in a clearer view of all manner of rebates, kickbacks and other fee-splitting devices.

MASSACHUSETTS MEDICAL SOCIETY

DEATHS

DOUCETT — Frederick L. Doucett, M.D., of East Weymouth, died on June 19. He was in his seventy-ninth year.
Dr. Doucett received his degree from Tufts College Medical School in 1900. He was formerly a member of the Weymouth Board of Health.
A daughter, two brothers and a sister survive.

FELCH — Carrie I. Felch, M.D., of Boston, died on June 11. She was in her eighty-sixth year.
Dr. Felch received her degree from Tufts College Medical School in 1906.
A nephew survives.

HOUGHTON — Henry L. Houghton, M.D., of Boston, died on June 17. He was in his eighty-first year.
Dr. Houghton received his degree from Harvard Medical School in 1894. He was formerly president of Hahnemann Hospital, Boston.
His widow and a daughter survive.

LINDSAY — Joseph I. Lindsay, M.D., of Grafton, died on June 6. He was in his eighty-fifth year.
Dr. Lindsay received his degree from University of Vermont College of Medicine in 1888. He was formerly a member of the staff of Worcester Memorial Hospital and was a fellow of the American Medical Association.
A son, two grandchildren and a sister survive.

MACCORISON — Carl C. MacCorison, M.D., of North Berwick, Maine, died on June 4. He was in his seventy-first year.
Dr. MacCorison received his degree from Dartmouth Medical School in 1906. He was formerly medical superintendent of the North Reading State Sanatorium and was a member of the Massachusetts Medical Society and a fellow of the American Medical Association.
A brother and two sisters survive.

PARE — Francis M. Pare, M.D., of Worcester, died on January 28. He was in his forty-sixth year.
Dr. Pare received his degree from Georgetown University School of Medicine in 1931. He was a member of the staff of St. Vincent's Hospital and a member of the New England Obstetrical and Gynecological Society.
His widow, mother, father, two sons, a brother and two sisters survive.

TORNEY — George H. Torney, M.D., of Brookline, died on June 1. He was in his seventy-sixth year.
Dr. Torney received his degree from University of Pennsylvania School of Medicine in 1894. He was a member of the American Psychiatric Association and the New England Society of Psychiatry and a fellow of the American Medical Association.
His widow and two sons survive.

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH

THERAPY OF ROCKY MOUNTAIN SPOTTED FEVER

Therapy for Rocky Mountain spotted fever is still in the developmental stage. The following is a résumé of information received from Dr. John W. Oliphant, of the Rocky Mountain Laboratory, Hamilton, Montana.

Para-aminobenzoic Acid (Paba)

Since 1945, published and unpublished reports of 135 cases treated with para-aminobenzoic acid have been collected at the Rocky Mountain Laboratory of the United States Public Health Service. The average mortality for the United States for Rocky Mountain spotted fever is 20 per cent; of the patients treated with paba, 14 died — a mortality of 10.3 per cent. In 4 of these cases treatment was stated to have been begun too late. In 8 of the remaining cases, no beneficial results were observed. In 78 cases, some physicians thought the paba had been quite beneficial whereas others considered it of value but not to such a great extent. In 35 cases, no opinion was expressed. Statistical analysis of these 135 cases was not possible because complete information was lacking from many of the reports.

Flinn et al.[1] recommended a blood concentration of 30 to 60 mg. per 100 cc. Para-aminobenzoic acid in an initial dose of 4 gm. and 2 gm. every two hours results in blood levels of 5 to 10 mg. per 100 cc. Some patients respond well to this dose. The two-hour interval of medication is necessary because of the rapid excretion of the drug in the urine. Continued administration for at least two days after the temperature has returned to normal is recommended to prevent relapse.

Para-aminobenzoic acid is relatively insoluble in water but has a solubility of about 1 gm. per 20 cc. in 5 per cent sodium bicarbonate solution. The bicarbonate may be useful in preventing nausea and acidosis. Paba is available in powder or tablet form. The sodium salt is soluble and may be used orally or intravenously. It comes in 0.5-gm. tablets, in sterile vials containing 4 gm. of salt and in ampoules containing 1 gm. of salt in aqueous solution.

Leukopenia has been reported during paba therapy. Agranulocytosis might result.

Supportive Therapy and Para-aminobenzoic Acid

The clinical studies of Harrell and his co-workers[2] and of Ravenel[3] have emphasized that with the development of Rocky Mountain spotted fever, dehydration, loss of serum protein and blood chlorides, acidosis and in some cases anemia occur. The treatment according to Ravenel[4] is as follows: the fluid

and electrolyte balance should be restored to normal by means of intravenous injections of glucose in physiologic saline, lactate or Ringer's solution and should be maintained at a normal level by oral intake of fluid and added sodium chloride. Intravenous injections of electrolytes in solution in a patient whose serum protein is too low will serve only to produce more edema and possibly circulatory failure with pulmonary edema. Acidosis may be corrected by intravenous or subcutaneous injections of sixth molar solution of sodium lactate in appropriate dosage. The serum protein level of the blood depleted in the disease by starvation, vascular damage and liver failure should be restored to normal by intravenous injection of plasma and, in emergencies, serum albumin. This level should be maintained by plasma and a high-protein diet. If anemia develops, blood should be given freely. Blood from patients convalescing from Rocky Mountain spotted fever is of no particular value. A high intake of vitamins should be furnished. Thiamin is given to help prevent shock. Ascorbic acid is given to obviate blood-vessel endothelial damage, and vitamins B complex and K for liver damage and to reduce increased prothrombin time. Depending on the size of the patient 0.5 to 1 gm. of para-aminobenzoic acid per pound of body weight per day is given. Small children receive 1 gm. per pound; very large children, half that amount; and the intermediate, about 0.75 gm. This is partially buffered with 10 cc. of a 5 per cent solution of sodium bicarbonate per gram to prevent acidosis and nausea, and is given at two-hour intervals. The blood level of the drug should be estimated each day, in each case the same length of time after a dose of the drug. A level of 30 to 60 mg. per 100 cc. is desirable; 60 to 80 mg. may be hazardous. Administration is continued four or five days after the temperature has reached normal.

The toxic effects of para-aminobenzoic acid to be watched for are acidosis, leukopenia, abdominal distention and delirium. If the white-cell count falls to 3000, the paba should be discontinued. Tympanites and delirium occur fairly frequently but are probably of little importance.

The complications of Rocky Mountain spotted fever are congestive heart failure (for which oxygen and digitalis in full dosage are helpful), pneumonia (usually lobar and rickettsial, ordinarily not helped by penicillin), encephalitis and thrombophlebitis. The heart failure is usually reversible, and when recovery occurs it is complete. It is possible but extremely difficult to treat these patients without laboratory control. Frequent determinations of the carbon dioxide combining power, serum protein and para-aminobenzoic acid levels of the blood are virtually a necessity, and determinations of the nonprotein nitrogen and chloride blood levels and prothrombin time may be a valuable aid.

Rocky Mountain spotted fever causes extreme vascular damage. Intravenous fluids used in therapy should be given cautiously to guard against unfavorable reactions.

Serum

Hyperimmune rabbit serum has been shown to have a definitely protective and therapeutic effect in experimental animals if used early during the infection. It has been employed in numerous human beings and appears to be beneficial, particularly if administered before or shortly after the rash appears. It is available commercially from Lederle and Sharp and Dohme. The recommended dose is 1 cc. per kilogram of body weight. Directions for testing the patient's sensitivity to rabbit protein and dosage accompany the antiserum.

Neoarsphenamine in metaphen solution, penicillin and sulfonamide drugs have been tried with no evidence of any beneficial results.

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MISCELLANY

DR. DeWITT C. ROMAINE FELLOWSHIP

Columbia University College of Physicians and Surgeons has received a bequest, amounting to approximately $140,000, from the estate of the late C. Evaretta Romaine, it was recently announced. The fund, which will be set up as the Dr. DeWitt C. Romaine Fellowship, will be used to investigate diseases of the blood system and other medical problems.

VETERANS ADMINISTRATION

Dr. Augustus Thorndike, of Boston, has been appointed director of Veterans Administration Prosthetic and Sensory Aids Service. Dr. Thorndike, who graduated from Harvard Medical School in 1921 and served overseas with the 105th General Hospital, developed and directed the Army's reconditioning program for disabled soldiers. He was awarded the Legion of Merit for this work.

WHO PROGRAM

The Interim Commission of the World Health Organization, which now consists of 43 nations — 33 UN members and 10 nonmembers — has declared its program for 1949. It is proposed to concentrate on four international problems — malaria, maternal and child health, tuberculosis and venereal disease. Forty-four other medical and related fields will also be included in the Commission's activities. Work on an international pharmacopoeia is also progressing under the aegis of the Expert Committee on the Unification of Pharmacopoeias.

CORRESPONDENCE

SUSPENSION OF REGISTRATIONS

To the Editor: It has come to my attention that through a clerical oversight in this office, you were not notified that the registrations of several physicians were suspended because of their failure to comply with our statutory requirement concerning United States citizenship.

Under Chapter 415, Section 3, of the Acts of 1939, all physicians registered by the Board must satisfy the Board that they are American citizens. An attempt was made to communicate with such physicians whose applications indicated that they were born outside the United States. As a result of the information received, on July 12, 1946, the Board voted to suspend the registrations of the following physicians because they have stated they are not citizens of the United States or do not intend to become citizens:

Walter Bergwell	Lund, Sweden
John R. Corbett	Summerside, P. E. I.
Arthur G. Corea	Boston, Mass.
Derek Denny-Brown	Boston, Mass.
Robert H. Ells	Ottawa, Ontario
Hubert Giovannetti	Sydney, Nova Scotia
Arthur M. Goulding	Toronto, Ontario
Marion Hook	Hastings, England
William M. Lynch	Sherbrooke, Quebec
Sidney H. McPherson	West Hartford, Conn.
Geraldine Oakley	Calgary, Alberta
Margaret Parks	St. John, New Brunswick
Elizabeth Ross	Meadowville, Nova Scotia
John R. Ross	Poughkeepsie, New York
Howard H. Smith	Charlottetown, P. E. I.
Edward V. Sullivan	Fairville, New Brunswick
Everett O. Thomas	St. Stephen, New Brunswick
Stephen B. Thorson	Winnipeg, Manitoba
Edmund Eugene Walker	Springfield, Mass.

H. QUIMBY GALLUPE, M.D., *Secretary*
Board of Registration in Medicine

State House
Boston

BOOK REVIEW

Congenital Malformations of the Heart. By Helen B. Taussig, M.D. 4°, cloth, 618 pp., with 177 illustrations. New York: The Commonwealth Fund, 1947. $10.00.

This volume has long been awaited by the pediatrician and the specialist in cardiovascular disease. Ten years have elapsed since Gross first successfully ligated a ductus arteriosus. This decade has witnessed the emergence of congenital heart disease from its obscurity as the academic diversion of the ultraspecialist to a position of importance in the consciousness of the practitioner and even of the layman. This evolution has been in large measure the result of a series of brilliant surgical procedures and the development of improved methods of study (notably angiography and cardiac catheterization). For the past twenty years Dr. Taussig has been intimately concerned with this progress, and she is responsible for the fundamental clinical observation upon which the now well known Blalock–Taussig operation is based. This timely volume reflects the author's wide experience in this field.

The book is divided into four parts. The first deals with basic principles, methods of diagnosis and the physiology of the malformed heart. The second concerns malformations of the heart in which there is difficulty in supplying the body with adequate oxygenated blood. The third involves malformations compatible with life for many years, and the fourth is devoted to therapy.

The arrangement of the book is logical. The style is readable and direct, and frequent diagrams of the altered circulation are most helpful in elucidating the more complicated defects. The text is further strengthened by a summary at the end of each important discussion. Perhaps in some instances these summaries would have been more forceful had they been shorter. The illustrations are generous and effective.

This volume is destined to take its place beside the important studies of Maude Abbott as a standard reference for those concerned with this special field.

BOOKS RECEIVED

The receipt of the following books is acknowledged, and this listing must be regarded as a sufficient return for the courtesy of the sender. Books that appear to be of particular interest will be reviewed as space permits. Additional information in regard to all listed books will be gladly furnished on request.

Andreas Vesalius Bruxellensis: The bloodletting letter of 1539. An annotated translation and study of the evolution of Vesalius's scientific development. By John B. de C. M. Saunders, F.R.C.S. (Ed.) and Charles D. O'Malley. 8°, cloth, 94 pp. New York: Henry Schuman, 1947. $5.00. Limited to 500 copies.

It is noteworthy that this is the first published translation into English of a complete work of Vesalius. Professor Charles U. Clark, of Toronto, had previously made an unpublished translation of the venesection letter, which was made available to the authors, who checked it with their manuscript. The authors in their introduction trace the scientific development of Vesalius, placing the letter on venesection midway between his pure Galenical anatomy, as shown in his recension of Gunter's *Institutiones anatomicae* (1538) and his scientific treatise on anatomy, the *Fabrica* (1543). They point out that Vesalius not only was an anatomist but also was greatly interested in the whole field of medicine. The venesection problem is considered in all its aspects, beginning with the writings of Hippocrates, Galen and other classic writers and ending with the controversy of the contemporaries of Vesalius. The scholarly annotations to the introduction and the text are invaluable. The publishing is excellent in every way. The monograph should be in all medical-history collections.

Private Enterprise or Government in Medicine. By Louis H. Bauer, M.D. 8°, cloth, 201 pp. Springfield, Illinois: Charles C Thomas, 1948. $5.00.

Dr. Bauer, a trustee of the American Medical Association and currently president of the Medical Society of the State of New York, in this monograph presents a study of the proposed socialization of medicine by the federal Government and the counterproposals by the American Medical Association and the proponents of voluntary sickness insurance. The preliminary chapters discuss the state of medical care in the United States, the growth of Government in medicine and public health and foreign medical systems and their comparison with American systems. The following chapters consider the compulsory-sickness-insurance movement through 1944, and the legislation before Congress in 1945 to 1947. The various bills, including the Sheppard–Towner Act, the first Wagner bill of 1939, the Wagner–Murray–Dingell bill of 1943, the second bill of 1945 by the same group of senators, the third bill by the same group introduced in 1945 and providing for a national health program, the Fulbright–Taft bill of 1947 and the Taft–Smith–Ball–Donnell bill (S. 545) of 1947, are analyzed and discussed in relation to the problem of adequate medical care for the people of the United States. Also are considered and analyzed the voluntary insurance system and the ten-point plan of the American Medical Association. Included is the famous message to Congress of President Truman, dated November 19, 1945, requesting legislation for adoption of a national health program, and discussion of the work of the Committee on the Costs of Medical Care, the National Health Survey of 1935 and the National Health Conference of 1938. A chapter is devoted to the development of the voluntary insurance system in the United States. A bibliography of pertinent references is appended to the text. The book is well published in the characteristic good style of the publisher. It should be in all medical and general libraries and read by all physicians interested in the problem of the socialization of medicine.

Endocrine Therapy in General Practice. By Elmer L. Sevringhaus, M.D., director, Endocrine and Nutritional Clinics, Gouverneur Hospital, New York City. Sixth edition. 8°, cloth, 264 pp., with 49 illustrations. Chicago: The Year Book Publishers, Incorporated, 1948. $4.00.

This book, first published in 1938, has passed through six editions and seven printings, speaking well for its soundness and popularity. This new edition has been carefully revised to keep it abreast of current knowledge in its field. Although no major changes have been made in the text, about a third of the pages have been altered. The printing is well done with a good, large type that is easy to read. The book is recommended for all medical libraries and should prove valuable to physicians interested in the subject.

Illustrative Electrocardiography. By Julius Burstein, M.D., visiting electrocardiographer and chief of the Cardiac Clinic, Morrisania City Hospital, New York City, and associate cardiologist and chief of the Cardiac Clinic, Jewish Memorial Hospital, New York City; and Nathan Bloom, M.D., associate professor of medicine and chief of the Department of Electrocardiography, Medical College of Virginia, Richmond. Third edition. 8°, cloth, 309 pp., with 99 plates. New York: D. Appleton–Century Company, Incorporated, 1948. $6.00.

This work, first published in 1935, has been thoroughly revised to bring it up to date with the significant advances in its field. All but two of the ninety-nine plates are new. A chapter on radiology of the heart by Dr. Philip Slater has been added. A good index concludes the volume. The publishing is excellent.

The Case of Rudolf Hess: A problem of diagnosis and forensic psychiatry. By the following psychiatrists in the Services who have been concerned with him from 1941 to 1946: Henry V. Dicks, M.D., J. Gibson Graham, M.D., M. K. Johnston, M.D., D. Ellis Jones, M.D., Douglas McG. Kelley, M.D., N. R. Phillips, M.D., and G. M. Gilbert, Ph.D. Edited by J. R. Rees, M.D. 8°, cloth, 224 pp. New York: W. W. Norton and Company, Incorporated. $3.00.

This monograph constitutes a case history of Rudolf Hess by the eight British and American psychiatrists who were concerned with him from 1941 to 1946. The case is studied from the time Hess parachuted into England, in May, 1941, until his appearance before the Nuremberg tribunal in 1946. The last chapter is a general review of the case, and the considered opinion of the psychiatrists favors a diagnosis of schizophrenia of a paranoid type. An appendix contains the documents presented to the Nuremberg court. The book is well published and reasonably priced. This unusual case history should be in all psychiatric collections.

An Introduction to Gastro-Enterology: A clinical study of the structure and functions of the human alimentary tube. By James D. Lickley, M.D. 12°, cloth, 143 pp., with 21 illustrations. Baltimore: The Williams and Wilkins Company, 1947. $3.00.

This small manual was written for senior medical students and beginning practitioners in the field of gastroenterology. The text is well written and well organized, and the volume well published. The printing was done in Great Britain.

A Manual of Clinical Therapeutics: A guide for students and practitioners. By Windsor C. Cutting, M.D., professor of therapeutics, Stanford University School of Medicine, San Francisco, California. Second edition. 12°, cloth, 712 pp., with 30 illustrations. Philadelphia: W. B. Saunders Company, 1948. $5.00.

This manual, first published in 1934, has been revised to bring it up to date. Material has been added, especially on the antibiotics, antimalarias, antihistamines, antithyroid drugs, anticonvulsants, folic acid and plasma fractions. Exact dosages for children have been inserted in an appendix. Diet lists and a number of illustrations have been added to the text. The various appendixes of special procedures, physiotherapy, symptoms and treatment of poisoning, diet lists, metric and English equivalents, tables and charts for weight, height and age, prescription abbreviations and other data, clinical and physiologic data and a list of prescriptions, drugs and doses add much to the value of the work. Especially valuable is the list of therapeutic agents and dosages. The volume is well published and should prove useful as a ready reference source to all medical librarians and physicians.

Advances in Military Medicine: Made by American investigators working under the sponsorship of The Committee on Medical Research. Edited by E. C. Andrus, D. W. Bronk, G. A. Carden, Jr., C. S. Keefer, J. S. Lockwood, J. T. Wearn and M. C. Winternitz. Associate editor: Tuckerman Day. With a foreword by Alfred N. Richards. In two volumes. 8°, cloth. Volume I, 472 pp., and 62 illustrations. Volume II, 900 pp., and 94 illustrations. Science in World War II. Office of Scientific Research and Development. Boston: Little, Brown and Company (An Atlantic Monthly Press Book), 1948. $12.50 for the two volumes.

The work describes the activities of the Committee for Medical Research of the Office of Scientific Research and Development and constitutes a history of medical progress during World War II. The Committee was established in June, 1941, by presidential order, and nearly 1700 physicians and 3800 scientifically trained research workers were associated with the Committee. Its staff was divided into six sections: medicine, surgery, physiology, chemistry, aviation medicine and malaria. The material in the two-volume set is arranged in the same divisions, with supplementary chapters on penicillin and sensory devices. In the section on chemistry there are a number of papers on chemical-warfare agents and antipest agents. In physiology are discussed shock, plasma, blood substitutes and whole blood, problems of nutrition, water disinfection, acclimatization to heat and cold and protective clothing. In medicine the principal topics are infections and venereal and tropical diseases. Aviation medicine includes the study of crash injuries, effects of acceleration, visual problems, motion sickness, anoxia and altitude-decompression sickness. Surgery includes papers on infection, wound healing, orthopedics, gas gangrene, burns, peripheral nerve lesions, concussion, frostbite and trenchfoot and surgical plastics and hemostatics. Malaria is considered in five chapters. A good index concludes the text, which is paged continuously through the two volumes. There is a large bibliography of the writings of persons working on contracts with the Committee and a list of the contracts. The publishing is good in every way. The work is recommended for all medical and general libraries.

Experimental Air-Borne Infection. By Theodor Rosebury. With the co-authorship and assistance of the staff of the Laboratories of Camp Detrick, Maryland. 8°, cloth, 222 pp., with 75 tables. Baltimore: The Williams and Wilkins Company, 1947. $4.00. *Microbiological Monographs.* Official Publication of The Society of American Bacteriologists.

This report presents the major results of a co-operative wartime project carried out at Camp Detrick, beginning in December, 1943, and ending after the cessation of World War II. A special blood chamber was constructed and after safety tests had been made and found satisfactory, work with infective agents was begun March 21, 1945, and continued until the project was terminated. The text is divided into five sections, the first four considering the history of the subject, equipments and methods, the selection of an atomizer and basic data. Section five discusses the stability and infectivity of a group of special bacteria and viruses. A summary concludes the text. The material is well arranged, and the text well written. The volume is well published in every way. It forms the first volume of a new series of microbiologic monographs and is an official publication of the Society of American Bacteriologists. It is recommended for all medical libraries and public-health collections.

Fundación Lucas Sierra. Hospital de Viña del Mar. Journadas Clínicas de Verano, 1947. 4°, paper, 304 pp., with 46 illustrations. Viña del Mar, Chile: Fundación Lucas Sierra, 1947.

This volume constitutes the proceedings of a three-day clinical conference held at Verano, Chile. Papers were read by specialists on special anesthesia, salivary lithiasis, diabetes, cholecystitis, allergy, diseases of the biliary tract, leukemia, surgery of the thorax, heart and hypertension, the biliary tract, and hospital organization. The volume is well published and should be in all large medical libraries.

(*Notices on page xi*)